

Contents—April 1939

Volume XX

No. 4

ARCHIVES OF PHYSICAL THERAPY

DISRAELI KOBAK, M.D., Editor

Suite 712 — 30 North Michigan Avenue, Chicago, Illinois

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Subscriptions — In the United States, its possessions, and Mexico, \$5.00 yearly; Canada, \$5.50; elsewhere, \$6.50 the year.

Advertising rates on application. All advertising copy subject to acceptance by publication committee.

Published monthly at Chicago, Illinois, by American Congress of Physical Therapy.
Entered as Second Class Matter January 29, 1938, at the Post Office at Chicago, Illinois, under the Act of March 3, 1879.

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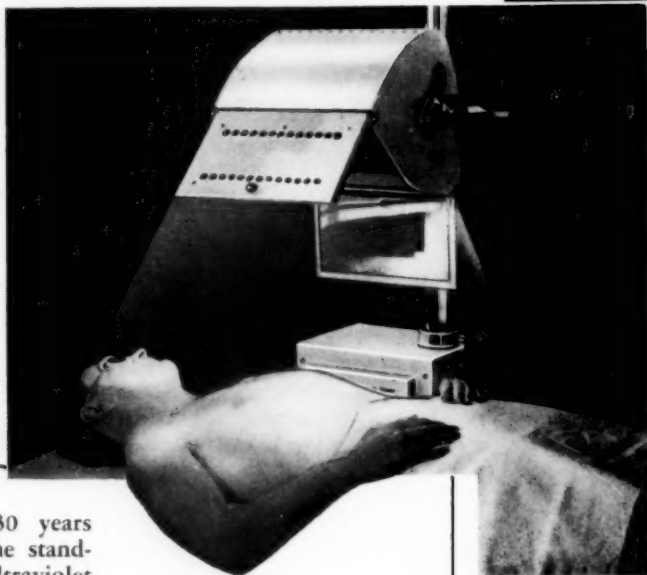
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INDICATIONS AND TECHNIC OF IONTOPHORESIS *

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University of California Hospital

SAN FRANCISCO

Ionic therapy has had many rises and falls in popularity since 1900, when Professor Leduc of Nantes, France, first used this method of introducing ions into the tissues of the body. He hoped that iodine so conveyed directly over the thyroid would prove more efficacious in the treatment of thyroid toxicosis than when the drug is given by mouth. He treated septic conditions with zinc ions. Zinc, copper, mercury, quinine, cocaine, iodine, chlorine, and salicylic acid have all been used for various conditions. It was soon learned, however, that ions can be introduced only into the most superficial layers of the skin or mucous membrane. The ions of zinc and copper are still used for ulcers and other superficial infections; chlorine is used to soften scar tissue; and salicylic acid is used in the treatment of arthritis. The popularity of this method of treatment varies tremendously in different clinics and it is difficult to estimate results when, in most instances, so much dependence must be placed on impressions.

In recent years, otorhinolaryngologists have employed zinc iontophoresis, with considerable variation in methods of application^{1, 2} and their conclusions as to results. In 1934, Warwick³ introduced the idea of iontophoresis in the treatment of hay fever and he, Alden⁴ and a number of others found this method to be of great value. Bernheimer⁵, however, failed to achieve so high a percentage of good results, and Ramirez⁶ reported disappointing results with such therapy. Bernheimer, indeed, considered the results achieved by the use of escharotics to be just as satisfactory. Hara⁷, using a comparative series, found that palliation lasted longer after ionization than it did after the use of escharotics. Zinc and copper iontophoresis is of value in the treatment of ulcers, infected mucous membrane and the like, but other methods are simpler and just as satisfactory.

Effects of Histamine Iontophoresis

At the present time we are particularly interested in the vasodilators, histamine and acetylcholine. These drugs are of importance from the physiologic standpoint and all of us who see patients with disturbances of peripheral circulation whether caused by specific circulatory diseases or by arthritis in its various forms, cannot fail to be interested in the studies being made with these chemical substances. Though both are vasodilators, their actions are entirely different.

An histamine-like substance (Sir Thomas Lewis) is found in large quantities in all epithelial tissue (lung, viscera, skin), and is released when cells are damaged by injury of any sort. A definite three-fold reaction follows, which is exactly the same as that obtained when histamine is introduced into the skin, namely: (1) local reddening, (2) flare, (3) wheal formation. The local reddening arises from the fact that the histamine acts directly upon the minute vessels lying immediately under the area, relaxing them.

The red flare is caused through the stimulation by histamine of the small

* Read at the Seventeenth Annual Session of the American Congress of Physical Therapy, Chicago, September 12, 1938.

sensory nerve endings in the skin which carry an impulse to the axon passing down the side branch to its termination in the arteriole where acetylcholine may be the substance freed to cause dilatation of the arteriole. Since there is no evidence to show that parasympathetic nerves exist in the skin and none that acetylcholine is freed at the terminations of post ganglionic sympathetic nerves, this flare is most simply explained by Lewis^{8,9}. He claims that a so-called "nocifensor system" of nerves arises from the dorsal roots but does not belong to the sensory system; that the stimulus which provokes the flare arises locally since the nerve impulses pass out from a small place of injury and travel to small cutaneous arterioles which supply the whole flushed area. Each small area of skin, therefore, must be united through axonic nervous channels to all regions displaying vasodilatation. A branching system of axons incompatible with the function of sensory localization is needed to explain this local reflex. Whether acetylcholine is the substance freed at the endings of this system is not known.

A wheal results when the walls of the vessels increase in permeability, allowing fluid to enter the tissues. A sensation of itching is caused by urticaria. Both the formation of the wheals and the itching are connected with the local reddening and are caused by histamine alone. Acetylcholine acts very differently in causing vasodilatation.

Sir Henry Dale and his co-workers^{10,11} showed that acetylcholine is liberated at the endings of the parasympathetic nerves, that it is liberated at all endings of pre-ganglionic fibers in both sympathetic and parasympathetic nerves in the particular location at which it is liberated. Knowing that all of the tissues in the skin presumably are supplied only with sympathetic nerve endings we have to consider that the axon reflex may cause a "cholinergic" action in the sympathetic endings themselves or in the so-called nocifensor system of nerves of Lewis. Acetylcholine is rapidly destroyed by bodily fluids and blood by means of an esterase. Because of this rapid destruction it is not so valuable for therapeutic purposes as is acetyl-beta-methylcholine chloride¹² which is much more stable and effective even by mouth. Though all cholines have a muscarine and a nicotine effect, acetyl-beta-methylcholine chloride has a strong muscarine effect while the undesirable nicotine action is very slight. The muscarine action causes: (1) an inhibitory effect upon the heart (vagus); (2) peripheral vasodilatation with lowering of blood pressure; and (3) stimulation of gastric and intestinal peristalsis. Nicotine paralyzes the synapses in the ganglia between central and peripheral neurons in both sympathetic and parasympathetic systems so that stimuli cannot get through to the periphery. The actions of other choline compounds have been studied by Kovács, Saylor, and Wright¹³, but no other acts so definitely upon the circulatory system.

Both histamine and acetyl-beta-methylcholine chloride can be introduced into the skin by iontophoresis. Typical reactions are obtained. Histamine causes redness, formation of wheals with itching, and an increase in the temperature of the skin. The urticarial reaction disappears in 15 to 20 minutes, but the skin remains warm one to two hours. Acetyl-beta-methylcholine chloride causes redness, sweating, and "gooseflesh" due to stimulation of the erector pili muscles, and the skin remains warm 2 to 7 hours after the introduction of this substance.

Clinical Application

Many pathologic conditions are being treated by histamine or mecholyl (acetyl-beta-methylcholine chloride) iontophoresis with gratifying results. What the final place of each of these drugs will be, and how valuable the

introduction of the ions into the body by iontophoresis in the various diseased areas will prove to be, is still a matter of conjecture, but any work that is done with two such important physiologic substances as these will add to our knowledge of such chronic conditions as peripheral vascular disease and arthritis, and perhaps others.

Opinion differs as to the relative value of histamine and mecholyl in treatment. Deutsch¹⁴ was the first to use histamine acid phosphate solution (1:10,000) by iontophoresis. Kling¹⁵ reviewed the German literature and introduced the technic in this country. In the same year (1934), Joseph Kovács¹⁶ described a technic for the use of acetyl-beta-methylcholine chloride by iontophoresis in the treatment of peripheral vascular diseases and chronic arthritis.

To test the relative merits of the two drugs, Kling and Sashin¹⁷ placed a drop of 1 per cent mecholyl upon the skin and introduced it into the corium by means of needle pricks. This produced a smaller wheal, and a fainter flare than those obtained with a 0.10 per cent solution of histamine. They contended that, since the flare is an indication of the dilatation of the arterioles, the action of 1 per cent mecholyl solution is weaker than that of 0.10 per cent histamine solution not only on the capillaries but on the arterioles as well.

Since the physiologic action of histamine is so different from that of acetyl-choline and since the formation of wheals is due to the action of histamine, this test seems unsound. There is no question but that the immediate action of histamine is much more striking than that of mecholyl, but if the latter causes a more lasting dilatation of arterioles, this must be taken into consideration. These drugs have been used in the treatment of varicose ulcers, peripheral diseases, and arthritis with its various manifestations.

Varicose Ulcers.—Varicose ulcers present a discouraging problem. Many methods of treatment have been used. The etiology is of great importance in deciding upon what plan to follow for permanent results. For instance, Faxon¹⁸ urged ligation as the treatment of choice for insufficient saphenous veins. If the valves of the perforating branches have been shown to be insufficient and brawny edema and ulceration are the result, ligation and division of the perforating branches deep to the fascia is necessary and the brawny surrounding area as well as the ulcer must be excised. At the moment, however, only the healing of the ulcer is under consideration.

In 1936, Saylor, Kovács, Duryee and Wright¹⁹ reported favorable results with acetyl-beta-methylcholine chloride iontophoresis in the treatment of varicose ulcers. At that time they had treated 26 patients with ulcers that had existed from one week to 37 years and varied in size from 0.5 cm. in diameter to 11 by 6 cm. The ulcer healed in 24 of the 26 patients. In February, 1937, Kovács²⁰ reported his results in 54 patients, 11 of whom were still receiving treatment. Of 43 completed cases, only 2 showed unsatisfactory results.

In 1937, Murphy²¹ published the results of the treatment by iontophoresis of 33 patients with thrombophlebitis. He used the method of Joseph Kovács. Of the 33 patients, 27 had subacute phlebitis while only 6 had actual ulcers. He reported improvement in all but two who received only 9 and 5 treatments, respectively. The disease had been present from 1 month to 20 years. From 4 to 63 treatments, an average of 14.8 treatments each, were given. Relative to the 6 with ulcers, he reported "improvement" or "no edema," but "healing" took place in only one.

In September, 1937, we began the treatment of a small group of patients, sent to us from the clinic on varicose veins because their treatment had

proved difficult. The technic of Joseph Kovács was used. Reinforced asbestos paper was saturated with a 0.50 per cent solution of acetyl-beta-methylcholine chloride and wrapped about the leg from knee to foot avoiding open ulcers. Malleable metal plates were placed over the asbestos paper and connected to the positive electrode of a galvanic battery. A large, moist pad-electrode was placed on the back. A current of from 20 to 30 ma. was gradually turned on and continued for 30 minutes. Three treatments were given each week. No support, no injections, or any treatment other than a petrolatum dressing was used while this method was employed.

TABLE 1.—*Patients with Varicose Ulcers Treated by Mecholyl Iontophoresis*

Name	Age Sex	Duration of Ulcer	Size of Ulcer	Duration of Treatment	No. of Treatments	Results
1 C.C.T.	61 M	6 years	1.4 x 9 cm.	Sept., '37 to Apr., '38	72	Worse
2 M.H.	72 F	Over 10 years	6-8 cm. and en- circling leg	Sept., '37 to Dec., '37	17	No change
3 W.L.H.	66 M	4 years (compound fracture)	3 ulcers 3 x 1½ cm.	Sept., '37 to Apr., '38	75	Worse
4 J.N.J.	55 M	9 years (thrombo- phlebitis)	Brawny edema	Sept., '37 to Oct., '37	13	Ulcer 4 x 5 cm
5 C.S.	69 F	8 years	2½ x 4 cm.	Sept., '37 to Mar., '38	60	Healed
		Second	2½ x 4 cm.	Nov., '37 to present	45 plus	Closing slowly
6 J.D.	53 M	2 years fracture, spine	Multiple, small 1 cm.	Apr. to June, '38	20	Ulcers dis- charge less, more shallow
7 C.G.	64 M	7 years	Varicose eczema	May to June, '38	12	Not im- proved
8 C.C.		10 years	Varicose eczema	May to June, '38	6	Skin clear, good color

Unfortunately our results have been poor (table 1). Patient No. 4 (J. N. J.) stopped treatment because he became continuously worse. He had marked brawny edema but no ulcer when treatment was started; an ulcer developed while he was under treatment, and he returned to the varicose vein clinic where the ulcer again closed when support was used. One ulcer closed in patient No. 5 (C. S.) but a second opened while under treatment.

We realize that our series of patients treated is too small to permit scientific conclusions. We believe, however, that a new treatment is valuable only when one or more of the following conditions are met.

(1) The percentage of cures or of improvement is higher than by other methods.

(2) The method of treatment is simpler both for the patient and the physician.

(3) The treatment is less expensive.

The results achieved by the use of iontophoresis have not entirely fulfilled these conditions, (fig. 1, A, B and C). In our clinic the results with pressure using sponge rubber and adhesive strapping have been far more satisfactory than with mecholyl iontophoresis. Treatment by pressure is simpler in that the time required for each patient is far less at each visit, and visits are never oftener than once a week while three are required for iontophoresis. The relative cost of mecholyl and adhesive tape is probably about the same, as one gram of mecholyl in 200 cc. of water is sufficient for 4 to 5 patients treated consecutively, but when the time of the physician is considered the expense of iontophoresis is much greater. I note that

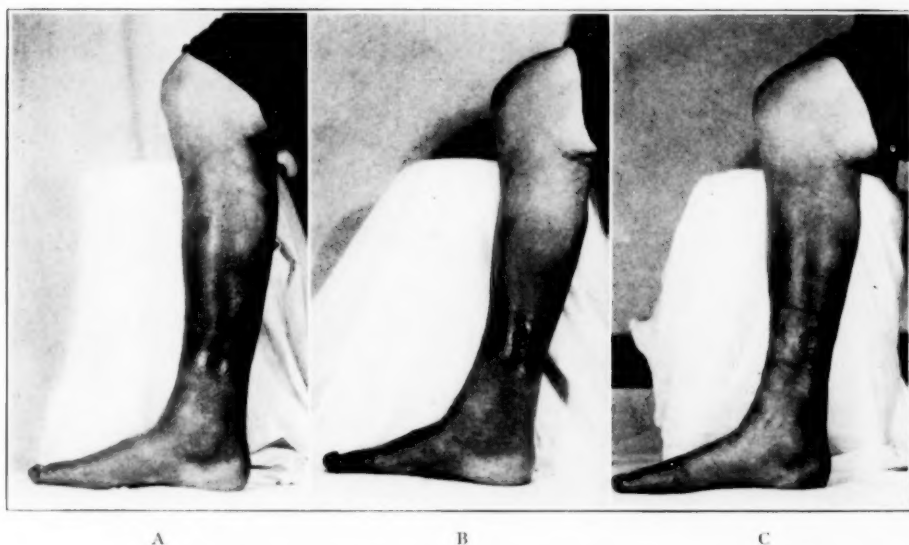


Fig. 1. — *A*, state of ulcer when treatment by mecholyl iontophoresis was started on October 4, 1937. *B*, result after 72 treatments with mecholyl iontophoresis, April 1, 1938. *C*, area of ulcer after application of pressure bandage, May 16, 1938.

Kling and Sashin¹⁷ have come to this same conclusion in their use of histamine.

On the whole, in the treatment of varicose ulcers, our results with acetyl-beta-methylcholine chloride in a small series of patients have been unsatisfactory. The method of pressure used in our varicose vein clinic gives results at least as satisfactory as those reported by Saylor, Kovács, Duryee, and Wright. The technic of treatment by pressure is far less time consuming and cheaper than the technic required for acetyl-beta-methylcholine chloride iontophoresis.

Vasodilatation in Peripheral Vascular Diseases

It seems physiologically reasonable that a method which will cause vasodilatation of the arterioles and capillaries should have at least temporary value in the treatment of patients suffering from peripheral vascular disease. Vasodilatation cannot be expected when there is definite occlusion of the vessel, such as exists in thromboangiitis obliterans or arteriosclerosis. In Raynaud's disease, in which vasoconstriction alone exists, increased circulation must occur when vasodilators are introduced. Since epinephrine is liberated at the nerve endings of the sympathetic system and stimulation of the sympathetic nerves causes constriction of peripheral arterioles, we can expect the direct antagonist of epinephrine, namely, acetylcholine to cause dilatation. We must, however, consider Lewis' "nocifensor nerve" theory to explain the action, as no parasympathetic nerves have been demonstrated. We can assume that acetyl-beta-methylcholine chloride acts directly upon the vessels themselves since it has been proved experimentally that acetylcholine is liberated at the endings of parasympathetic nerves to cause the reaction expected when parasympathetic nerves are stimulated.

Histamine hydrochloride supposedly acts by stimulating the sensory nerve endings to cause an axon reflex in the nocifensor system of Lewis, and hence vasodilatation of the arterioles.

We have treated five patients with advanced peripheral vascular disease by histamine iontophoresis, employing a 1 to 10,000 solution. Though the reactions were good, the results were not striking. We plan to con-

tinue this study. De Takats²² found that the skin often developed a refractory state, with increased pigmentation and thickening, and decided that liberation of vasodilator substances from the patient's own skin was preferable.

The results of Kovács, Saylor, and Wright²³ in the treatment of Raynaud's disease, and of Duryee and Wright²⁴ in scleroderma give hope for improvement in these conditions. Kovács, Saylor, and Wright treated 12 patients with Raynaud's disease throughout one winter. Four of these patients had ulcers which healed under treatment. Six patients had scleroderma. The skin softened sufficiently to allow free motion; all showed increased warmth, improved color of the hands and feet and a decrease in frequency and severity of attacks. Another patient with scleroderma, however, grew steadily worse under treatment.

Duryee and Wright used acetyl-beta-methylcholine to treat scleroderma (acrosclerosis) caused by peripheral vascular spasm. Though their results in Raynaud's disease by this method were only temporary, they felt that vasodilatation is of value in scleroderma. Surgical removal of sympathetic control of the peripheral circulation results in the release of spasm and the production of an abundant blood supply, but if scleroderma has produced a mechanical blocking of the vessels due to the tension of the leathery skin, vasodilatation by removal of sympathetic control is impossible. Duryee and Wright felt that iontophoresis causes softening of the thickened skin and vasodilatation, if treatment is continued over a long period. Twenty-seven patients received from 6 to 165 applications. Little change was noted in less than 10 treatments. Some patients stopped after 30 to 40 treatments because they were satisfied with their improvement. The authors felt, however, that at least 50 treatments are necessary in most instances, and many more are required if the condition is advanced.

Their criteria for classifying patients as "markedly improved" were: (1) restoration of essentially normal function; (2) healing of existing ulcers; (3) softening and loosening of the skin; (4) return of sweating and hair to the affected areas; and (5) increased visibility of capillaries (not always noted). Of their 27 patients, 9, who had from 33 to 165, an average of 81 treatments, showed marked improvement; 7, who had from 10 to 88 an average of 32, moderate improvement; and 11, who had from 6 to 20 treatments with an average of 11.8, slight or no improvement. In some of the earlier cases treated with good results the patients had remained in a satisfactory condition for 1½ to 2 years. Though De Takats²² did not report his results, he felt that mecholyl produces encouraging effects in scleroderma and also in thrombophlebotic induration.

Although Kovács and coworkers reported very temporary or no improvement in those peripheral vascular diseases in which obliteration is present, Kramer²⁵, using a 0.25 or 0.20 per cent solution of acetyl-beta-methylcholine chloride, treated 11 patients with thrombo-angiitis obliterans, obtaining "good" results in 3 (27 per cent) and some improvement in 3 (27 per cent) judging by the increased distance that they could walk before pain occurred. Of 8 patients with diabetic arthritis, 5 (75 per cent) showed "good" while one showed "some" improvement. Kramer also reported "good" results in 5 of 8 patients with vasospastic disturbance, and "good" results (100 per cent) in 3 patients with phlebitis. Many more patients must be treated and this method compared with others before it can be properly evaluated.

Arthritis is another chronic condition in which results of treatment are hard to evaluate. Changes in weather, in home and living conditions make a very great difference in how the patient feels. If he has had vari-

ous types of treatment, he reaches for a new one with renewed hope, so that a psychic factor enters the problem. There are always exacerbations and remissions to consider.

Arthritis and Vasodilators

Both histamine and mecholyl iontophoresis have been used extensively in arthritis and allied conditions. Kling¹⁵ (1934) reviewed the German literature describing the use of a 0.10 per cent solution of histamine acid phosphate by iontophoresis in 554 cases, and added some patients of his own he had treated by this method. It would seem that the various conditions which he mentioned, such as myalgia, contractures, joint affections, acroparesthesia and neuralgia could all be classed under the general head of arthritis or its manifestations. He felt that results particularly in myalgia make this a very important form of treatment.

In 1937, Kling and Sashin¹⁷ reported their own results in the treatment of 259 patients with vascular or arthritic disease and considered histamine iontophoresis the treatment of choice in myositis, bursitis, tenosynovitis and neuritis. Marked improvement was noted in patients with rheumatoid, osteoarthritic, and traumatic arthritis. They considered histamine definitely superior to mecholyl since the latter acts less on the capillaries and arterioles and requires more than ten times as high a concentration of the solution and several times as long a concentration of current and duration of treatment.

Richard Kovács²⁶ also preferred histamine ionization to mecholyl in treating rheumatoid myositis and neuritis and traumatic arthritis, since it brings about a more vigorous reaction. He²⁷ preferred acetyl-beta-methylcholine chloride, however, in the treatment of rheumatoid arthritis, stating that it gives subjective comfort, causes gradual elimination of swellings that have not advanced too far, and definite improvement in function. He considered it a treatment of choice in the local therapy of small joints. His results with osteoarthritis were not so satisfactory.

Martin, Eaton, Ruland, and Ruland²⁸ treated 83 patients with arthritis using a 0.25 or 0.5 per cent solution of acetyl-beta-methylcholine chloride for a period of 20 minutes with a current of from 20 to 30 ma. Thirty-six of the patients had infectious arthritis (7 mild, 11 moderate, and 18 severe) and 47 had hypertrophic arthritis (20 mild, 21 moderate, and 6 severe). On the whole those with mild infectious arthritis or with severe hypertrophic arthritis showed the greatest improvement in symptoms. Seventy-five per cent of those with infectious arthritis and 79 per cent of those with hypertrophic arthritis were improved. These authors believed that there is stimulating action of the drug on the muscles innervated by the parasympathetic system, which in some way increases the efficiency of the organism in readjusting its metabolic processes. In their opinion it is unreasonable to believe that the improvement is the result of a purely local change.

Boyd, Osborne, and Markson²⁹ reported the use of a 1 per cent solution of mecholyl in the treatment of 27 patients with arthritis. They failed to obtain satisfactory reactions with more dilute solutions. Their patients often tolerated a current of from 40 to 50 ma. for 20 minutes. They allowed an interval of 3 or 4 days between treatments and found from 18 to 20 treatments necessary before the maximum effect was achieved. In cases in which the arthritis, either rheumatoid or osteoarthritis, was not too far advanced, better results were obtained. Those with evident circulatory disturbances of the extremities, those with cool, pale, moist, and often cyanotic hands and feet seemed to gain most from the treatment. "It seemed most helpful in those who: (1) show the earlier changes of the rheumatoid type

with cool, damp, and cyanosed extremities, (2) have moderate hypertrophic changes with paraesthesia and sensitivity to cold, and (3) have sciatica or other manifestations of spinal nerve root irritation as a result of spinal arthritis." They were particularly impressed by the decreased fatigability in a large percentage of their patients, with a consequent increased indurance.

We have treated 41 patients with arthritis by histamine acid phosphate (1 to 10,000) iontophoresis. Our results are indicated in table 2. Patients

TABLE 2.—*Patients with Arthritis Treated by Histamine Iontophoresis*

Diagnosis	Treated	Number Treatments	Results
Hypertrophic arthritis			
Spine and large joints	12	3-20	Not so satisfactory as other methods.
Heberden's nodes			
Acroparesthesia	10	7-30	6 showed improvement with temporary relief of pain.
Rheumatoid arthritis			
Hands or feet	12	5-30	7 improved.
Traumatic arthritis	7	6-75	6 showed marked improvement. 1 failed to cooperate.
Fractured wrist (4)			
Sprained finger (1)			
Fractured humerus (1)			
Infected hand (1)			

with arthritis of the cervical vertebrae or with probable changes in the cervical spine which result in neuritis in the arms, causing thickening, numbness, and tingling of hands, frequently react very well to the vasodilatation obtained with histamine iontophoresis. Needless to say, the results are temporary because we are treating symptoms rather than causes. Cervical arthritis is treated by routine medical procedures, heat, massage, postural training, and the like. We have been very pleased with this method of treatment in those patients who have arthritis following injury or infection. We feel that we are reaching the cause—a vasoconstriction due either to direct stimulation of the sympathetic nerves by the injury, or to long restriction in a cast. This condition rarely occurs in patients under 45 years of age (fig. 2, A and B). The condition is stubborn and requires months of care with any method of treatment, but we have found the fingers softer, less thickened and more flexible following this form of treatment than they are after radiant heat or diathermy. All of our patients receive massage and exercise in conjunction with any preliminary method of vasodilatation.

We have treated two patients with acroparesthesia and four with rheumatoid arthritis with a 0.5 per cent solution of acetyl-beta-methylcholine chloride. It was applied to either hands or feet. The extremities remained warm for 3 to 7 hours following treatment. Salivation was noted by one. One of the patients with pain, numbness, and tingling caused by hypertrophic arthritis of the cervical spine preferred histamine to mecholyl as it seemed to give more symptomatic relief. The second patient with acroparesthesia received no histamine but we had to increase the solution of mecholyl to 1.0 per cent in order to give him any relief. The patients with rheumatoid arthritis were treated at different times with histamine and with mecholyl and the latter seemed to meet with more favor, though decision was difficult.

We cannot agree with Kling¹⁷ that the comparative value of the two drugs can be determined by the skin-test since we have to consider their physiologic actions as described by Lewis and by Dale. We expect histamine to act more directly upon the capillaries, and only secondarily upon the arterioles, while acetyl-beta-methylcholine chloride is expected to cause



Fig. 2. — *A*, patient was treated for a colles fracture. The fingers show a typical arthritic process, August 22, 1935. *B*, the hand after one month of treatment with histamine iontophoresis, massage and exercise, September 24, 1935. Treatment continued for a year.

vasodilatation of the arterioles probably due to stimulation of the nocifensor system of Lewis, and to cause direct stimulation of sweat glands and erector pili muscles. Due to the sudden reaction of histamine we can expect more immediate relief of pain, and it is probably for this reason that relief of the pain of acroparesthesia, bursitis, neuritis, is obtained with histamine, while the peripheral circulation so often involved in rheumatoid arthritis is increased for longer periods by mecholyl. Mecholyl must be used in at least a 0.5 per cent solution to give a worth while reaction.

Although we have relieved the severe pain of bursitis with histamine, we feel that, on the whole, both drugs are of much more value in the treatment of hands and feet, where we are dealing with disturbed peripheral circulation.

Though we wish to draw no conclusions as yet as to the importance of these drugs administered by iontophoresis or to their relative importance in various pathologic conditions, since both do cause vasodilatation, we feel that histamine is of more value in the severe pain of neuritis. Our results with this agent have been promising in traumatic arthritis, but it would appear that mecholyl gives greater promise in rheumatoid arthritis involving small joints particularly when peripheral vascular manifestations are present. This is not quite in agreement with Kotkis and Melchionna³⁰ who applied solutions of acetyl-beta-methylcholine chloride at various dilutions of 1-200 to 1-800 and found no difference in the reactions obtained in dogs provided a current of sufficient intensity (40 to 50 ma.) was applied. These dogs showed a decided drop in blood pressure with a compensatory increase in pulse rate and marked salivation. We have found that our patients do

not tolerate a current intensity of more than 25 ma. as a rule. This may explain the need for a solution of a higher concentration.

Conclusions

1. Histamine and acetyl-beta-methylcholine chloride are physiologic chemical substances worthy of study.
2. Mecholyl has been used in the treatment of varicose ulcers by iontophoresis but the results have not been as satisfactory as in the hands of others.
3. To estimate the value of these vasodilators in peripheral vascular diseases and in arthritis will require further study as much depends upon impressions, but theoretically the use of physiologic vasodilators seems sound.
4. Introduction of these drugs into the affected areas by the direct current causes an even dilatation of vessels over the treated area.

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Discussion

Dr. Richard Kovács (New York): Dr. Baker deserves high praise for her painstaking work in reviewing the literature so extensively, and for her critical and clinical observations. In general I fully agree with her as to the necessity of further studying definite uses of these modalities with clinical controls. The recent extended work with vasodilating drugs introduced by electricity has appropriately revived interest in the basic and simplest electric modality, the galvanic current. This current is a measure that any general practitioner can use. He can build his own outfit with a large radio battery, a rheostat and a milliampere meter. With the galvanic current he can treat a large number of conditions as the essayist pointed out.

When we speak of iontophoresis with histamine and mecholyl it is a misnomer, because we do not introduce ions, but rather molecules of these drugs. Hence it is more a form of cataphoresis, the transport of undissociated molecules from the positive pole. No definite studies have been made as yet about this fact and it is desirable that they be made. I think the term of electrophoresis is a more correct one to describe this method.

On the basis of over five years of experience I am convinced that we have a very valuable method of treatment with histamine and mecholyl in conditions commonly known as rheumatic and traumatic. The advantage of mecholyl iontophoresis in rheumatoid conditions is that depending on the deposition of the drug in the skin, it brings about a prolonged vasodilatation. Because the heating effect is chiefly located in the skin, it is a much more pleasant treatment in these hot days, for instance. To "bake" and to give diathermy is often an unpleasant experience for patients during the summer season. Therefore, electrophoresis is a very practical measure in hot weather that patients welcome with great relief. The clinical improvement following

is often exactly the same. There are also a number of patients who do not tolerate heat very well at any time, and for such individuals this is again a welcome form of treatment.

As to the difference between histamine and mecholyl I would simply make this statement: Mecholyl exerts a much milder effect and it can be used over large areas with comparative safety. It has the one great disadvantage at present that it is very expensive, a dollar a gram. We have found, however, that instead of the one per cent solution originally recommended, a quarter to a half per cent solution is efficient in most cases. Histamine is a much more powerful drug and for this reason it should be used only over smaller areas. In some cases of neuritis and traumatic conditions of muscles it has given us some very acceptable results.

Dr. Frances Baker (closing): I am very thankful to Dr. Kovács for his complimentary remarks. I might mention that we do not worry about "hot days" very often in San Francisco, so I had not thought of electrophoresis as a substitute for heating agents. We do want to use electrophoresis often enough and long enough to know what we can expect of it. I have the impression that histamine and mecholyl give more promise than have other chemicals introduced into tissues by the direct current. The peripheral vessels seem to remain dilated longer when these vasodilators are used than when radiant heat or diathermy are employed. However, we are treating chronic diseases for which we have no certain cure and the results at best are apt to be temporary. If we can stimulate peripheral circulation in either peripheral vascular disease or arthritis and so control symptoms we may feel amply repaid. When the physiology or etiology of these diseases is better understood more specific therapy may follow.

THE MEASUREMENT OF DOSAGE IN SHORT WAVE THERAPY

HOFRAT DR. J. KOWARSCHIK

VIENNA

For dosage in short wave therapy we were until now forced to rely exclusively on the sense of warmth of the patient, because we were lacking an objective measure of the energy of high frequency absorbed by the treated part. This situation was particularly unsatisfactory because precisely in short wave therapy the warmth felt by the patient is by no means a criterion for the energy taken up by the body. A part of the field energy, it will be recalled, enters the body without heating the skin and without creating a sense of warmth. The sense of heat therefore is tricked as it were. A portion of the high frequency energy is smuggled into the body through the skin and is transformed into heat in the depth. Since it is solely the skin that is provided with nerves for temperature sensation, that part which is absorbed beyond the skin does not create any sense of heating. Accordingly the feeling of warmth in short wave therapy presents no scale for the quantity of calories introduced in the body.

It was therefore but natural that for years efforts have been made to find an objective measurement for the dose of administered heat by short wave diathermy. Many reasons were responsible for past failures. To begin with it is in itself a difficult matter to measure high frequency energies within the range of such short waves as we employ in therapy, without however this being an impossibility. There are in radio technics a number of methods by which one can measure the energy yielded by a generator. These, however, are of no use for medical practice. It does not suffice to determine the power output of our therapeutic apparatus because we are not interested in the total output produced in the generator, but exclusively in that part of the energy which is absorbed by the body of the patient where it attains its therapeutic effectiveness. While in galvanization, faradization and diathermy the total energy yielded by the apparatus is absorbed by the body, this is not the case in short wave therapy. Here always only a portion of the total energy is exploited, while a part is lost by radiation into space. The amount of this loss varies according to the size and distance of the electrodes, the length of the cables, and the like, and may occasionally reach high values. Accordingly the output of each short wave apparatus consists of two parts, one which is utilized (therapeutic energy) and the other which is a loss of power by radiation. It is technically very difficult separately to measure the energy utilized from that which is lost or dissipated.

But even if one should succeed in this, not everything needed has been achieved. A method to be useful for therapy must fulfill a number of conditions which are not easily attained. They are: (1) It must be technically so simple that it can be applied by any intelligent technician. It also must not consume much time so that the duration of the treatment does not become too prolonged. (2) It must afford a correct scale for all cases occurring in practice, that is, for the application of various sized electrodes, electrode distances, their symmetric and asymmetric arrangements, and the like. (3) This result of measurement must be indicated by an instrument instantane-

ously and continuously so that there should be no need of determining it by calculating tables and charts.

Of all the methods that have so far been advanced that of Mittelmann, and his only, fulfills these requirements. It measures the energy absorbed by the body, that is the therapeutic output separated from the loss output, and at the same time is so simple that it is adequate for the practical therapeutic needs. Mittelmann's method is based on the principle of damping which we can explain in the following manner. If we regulate the treatment circuit of a short wave generator to resonance without there being a patient between the electrodes, no energy is practically transformed into heat. If, however, we place a subject between the electrodes, a portion of the freely oscillating energy is taken up by the subject and changed into heat. In this there takes place a drop of the tension existing at the electrodes. This drop of tension we designate as damping. If we use a meter (voltmeter) which indicates the tension existing at the electrodes, the indicator needle will show a lessening of its excursion. In this way we may measure the amount or the size of the damping. Mittelmann¹ himself has precisely described his method in the ARCHIVES to which we refer the reader. See also the contribution by Mittelmann and Kobak in the same journal.²

More than a year ago I had the firm of L. Schulmeister in Vienna construct for me an apparatus equipped with such a Mittelmann dosimeter. Naturally it was our first task to investigate whether the data of this appliance were correct under all conditions. It was essential to establish whether the instrument provides correct results with heating bodies of variable electrical conductivity, different dielectric constants, different size and shape of subjects and differently sized electrodes and electrode distances. For this purpose tests were made with: (1) Saline solutions or emulsions of water and oil. (2) The same liquids were tested in prismatic, cylindric and spheric vessels. (3) Various sized electrodes and different electrode distances with symmetric alternating and asymmetric arrangements.

When one knows the quantity of the liquid and its specific warmth and one measures the increase of temperature in a definite time, one can obtain the absorbed quantity of calories by a simple formula. If the number so found is multiplied by 4.18, one obtains the heat equivalent (1 gram cal. = 4.18 watt) of the absorbed high frequency quantity in watts. By comparing such a value with the one indicated by the instrument one is in a position to determine its exactness. At first I have undertaken in collaboration with H. Weisz a large number of such measurements. In the beginning we obtained alongside of correct data occasionally also considerable deviations. These soon were obviated by technical changes in the apparatus, so that finally the range of error of the measurements did not exceed ± 5 per cent even when very complicated asymmetric arrangements were selected.

After we were able to rely on the data of the dosimeter the next task was to determine the amount of the energy consumption in various therapeutic applications of the short waves. The aim was to obtain average values for the individual methods of treatment and to establish a table of dosages. In these determinations we naturally had to find a support by the subjective sensation of warmth of the experimented individuals. To obtain a uniform basis for these caloric data we selected four stages of heat sensation: (1) that which corresponded to a stimulus threshold, that is to say, when a just perceptible sense of warmth was obtained. (2) that when a slight pleasant warmth was experienced; (3) that when the heat became strong but tolerable; and (4) that stage which caused a sense of unpleasant heat which eventually became intolerable.

It was to be assumed that the data concerning these four stages of

heat sensation would fluctuate within certain limits with different individuals. For this reason we always treated a large number of persons under equal conditions. Let us illustrate the manner of such a measurement by one example. A knee joint was heated. The patient sat on a chair. The knee was bared and flexed at a right angle. At the median and the lateral side was applied a round electrode with a surface area of 100 sq. cm. at a distance of 2 cm. Next we determined the number of watts which appeared at the above stated four stages of sensation. The result of such a test with ten persons is shown in table 1.

TABLE 1. — *Treatment of Knee With Two Electrodes of 100 Sq. Cm. Size at Distance of 2 Cm., Showing the Individual and Average Values in Watts.*

	Damping	Number of Watts for the Stages of Heat Sensation			
		Stage 1	Stage 2	Stage 3	Stage 4
Patient 1	59	25	32	40	52
" 2	60	27	34	40	54
" 3	54	22	28	38	50
" 4	60	22	28	40	50
" 5	65	25	35	43	55
" 6	59	22	28	34	45
" 7	60	22	28	39	50
" 8	63	26	35	48	56
" 9	52	26	35	45	57
" 10	58	25	30	38	43
Averages	59	24	31	40	52

If we survey in this table the number of watts which correspond to stage 1 (threshold), it is seen that they fluctuate between 22 and 27. The deviations therefore were not very pronounced. The same holds good for the other three stages. If we calculate the arithmetic averages of the ten observations we obtain a stimulus threshold at 24 watts, a mild state at 30, a strong heat sensation at 40, with the limit of tolerance beginning at 50 watts.

These values naturally hold good only for the treatment of a knee joint under the definite conditions stated above. It was to be foreseen that the numbers would change when the conditions of heating, that is, size of electrodes and electrode distances, would be altered. Considering that in practice almost every physician makes use of a different technic, it was necessary fundamentally to examine the influence of the size and distances of electrodes on dosage. For this purpose the knee joint was heated with differently sized electrodes at various distances.

For the heating we made use of Kowarchik's electrodes (Münc. Med. Wchnschr. 6:219, 1938). These are round metal disks which are insulated at both sides with plexiglass. They are light and cannot be broken. There is a small hole in the middle through which may be pushed a measuring rod calibrated in centimeters so that the distance of the electrode from the body can be determined with precision. The electrodes are manufactured in four different sizes which we have designated by the Roman numerals I, II, III, IV (table 2). In table 3 we show the result of a large number of measurements which we have obtained with heating of a knee joint under various conditions. Each experimental series represents an average value of 5 to 10 measurements.

TABLE 2. — *Different Sized Electrodes.*

Size	Diameter in Cm.	Approximate Sq. Area in Cm.
I	16.0	200
II	11.3	100
III	8.0	50
IV	3.6	10

Influence of Size and Electrode Spacing

If we desire to learn the influence of the size of electrodes we naturally must compare only those values given in table 3 in which the electrode distance from the body was equally maintained. This applies for example to series 1, 5 and 8 (see table 3) in which the spacing distance of the electrodes from the knee was 3 cm. We see that for stage 1 with electrodes size I, II, III, the values corresponded to 27, 17 and 10 watts, respectively. Inasmuch as size I is the largest electrode, it follows that the value in watts which produces a definite sensation of warmth is the greater the larger the surface of the electrodes. This is confirmed also by the experimental results for the heat stages 2, 3 and 4. This is by no means surprising for we had to expect such a result because we have seen the same behavior also in classic diathermy. In diathermy, too, the intensity of the current increases with the size of the applied electrode which must be utilized if one desires to obtain a definite sensation of warmth. The larger the electrode the greater is the radiated mass of the body and the more calories or watts are needed by us to obtain a definite rise in temperature.

TABLE 3. — *Heating of Knee Joint With Different Sized Electrodes at Various Distances. Values in Watts in the Four Heat Stages.*

Experimental Series	Size of Electrodes	Electrode Distance	Damping	—Values in Watts for Heat Stages—			
				1	2	3	4
1	I	3 cm.	53	27	39	52	57
2	I	7 cm.	21	10	13	18	22
3	II	1.5 cm.	80	29	33	53	65
4	II	2 cm.	59	24	31	42	57
5	II	3 cm.	33	17	22	27	45
6	III	1 cm.	80	32	44	50	56
7	III	2 cm.	33	19	24	30	35
8	III	3 cm.	21	10	13	17	25

For this study we have until now no analogy in electrotherapy, because in galvanization, faradization and classic diathermy we work with contact electrodes. If we consider this problem theoretically we could assume that with increased spacing of electrodes there is also an increase of the bodily surface which is affected by the electric field. As the lines of force of the electric field usually diverge, the cross section of the field at the bodily surface must be the larger, the farther the electrode is separated from the body. We could therefore expect that with increasing distance of the electrode the number of watts which is needed for a definite sensation of warmth would rise. This, however, is not the case, as is shown by the experiments. When we compare the experimental series 1 and 2 in which equally sized electrodes were used at different distances, we obtain for a spacing of 3 cm. values in watts of 27, 39, 52 and 57, while for a distance of 7 cm. the numbers are 10, 13, 18 and 22. Thus we see that with increased spacing of the electrode from the body the number of watts for a definite stage of warmth decreases.

Accordingly the size and the distance of electrodes have an effect on the intensity of dosage in an inverse ratio. While with the size of the electrodes the dosage increases, it is decreased by spacing. This renders the conditions unusually complicated. We can attain with the electrode size I the stimulus threshold one time with 27 and another with 10 watts. If we take the electrode size II we can attain the same goal, one time with 29 and another with 17 watts. Thus we see that the dosage may fluctuate within the widest limits according to the external conditions of treatment.

All that we have said for the knee joint in detail was also observed by

us with other parts of the body. Naturally each such part requires another dosage, which again varies according to the circumstance of using large or small electrodes and selecting large or small distances from the body. As each physician employs a different technic, a table of dosages to be useful for all practitioners would have to take into consideration not only the various bodily parts and organs but also the values in watts for every and all imaginable sizes and distances of electrodes. To this would have to be added a gradation according to the intensity of heating. This would result in an immense number of figures. It is therefore immediately clear that this way of obtaining dosages is impractical, and that in this way the problem of dosage cannot be solved. Dosage had to be established on a different basis. There had to be found a simple relation between the dose and another measurable datum. This datum we found in the damping.

Influence of Damping

As already alluded to we understand by damping the drop of tension which occurs when we place a subject between the two electrodes.* If the electrodes are connected with a tension meter we can tell by the return of the index needle the size of the damping.

The damping depends upon three factors: 1. The treated mass and shape of the body. The larger the mass, the greater the damping. Accordingly in treating the thorax or abdomen the drop of tension will be larger than in a knee joint. 2. Size of the electrodes. If we compare the various dampings in table 3 corresponding to the electrode sizes I, II and III at an equal spacing of 3 cm., we obtain values of 53, 33 and 21 watts. It is evident from this that the damping increases with the size of the electrodes. This is understandable since with the size of the electrodes there is also an increase of the treated bodily mass. 3. Spacing of electrodes. If we use electrodes of size II at distances of 1, 5, 2 and 3 cm. it appears, as can be seen in table 3, that the damping is the smaller the more the distance from the body is increased, that is, the more air there is between the electrodes and the treated bodily part.

This shows that damping is determined by the size of the electrodes, their spacing, as well as the nature of the treated part. Accordingly it is influenced by all the external factors which must be considered in actual therapy. This suggests the advisability of establishing the relationship between damping and treatment dosage. If we arrange the damping values in table 3 according to their size and place opposite them the appropriate number of watts we obtain the following relationships (table 4):

TABLE 4. — *Relationship Between Damping and Therapeutic Dosage.*

Damping	Watts
80	29—30
53—59	24—27
33	17—19
21	10

We see that the greatest damping values correspond to the largest, and the lowest damping values to the smallest number of watts. The same thing found here for the knee joint was demonstrated by us also for other parts of the body. In this way was found a simple relationship between damping and dosage; namely, the dosage increases with the damping.

With this recognition we tried to build up a table of dosages. We ar-

* Note. — Damping is here defined as the number of scale divisions by which the deflection drops from resonance reading, for instance, 50 degrees with no load between the electrodes to the actual reading obtained when the apparatus is tuned to resonance with patient in the circuit.

ranged from a very large number of experiments all dampings that were found without regard to the treated bodily part and the sizes of the electrodes in "tens," e.g. 1-10; 11-20, etc., up to the highest values of 81-90. The doses in watts corresponding to these "tens" were arranged in as many groups, and for each of these groups we calculated the arithmetic average.

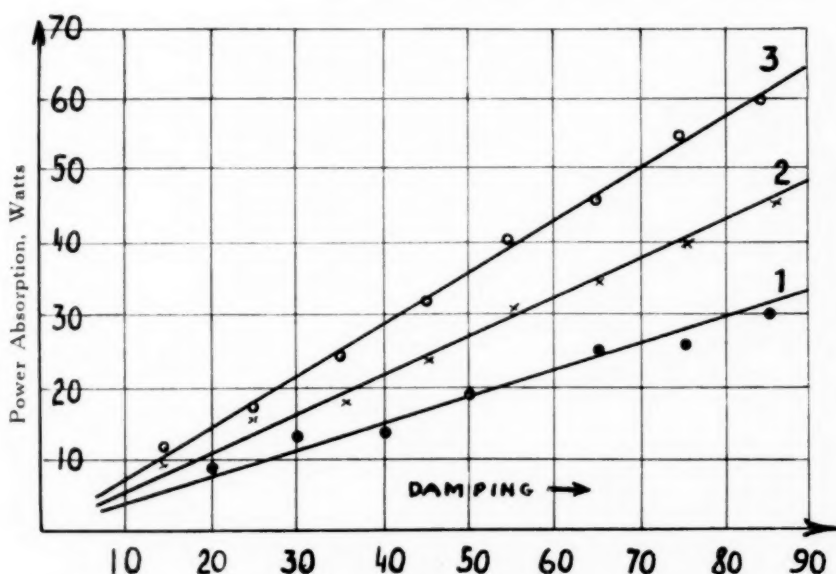


Fig. 1. — Dosage chart valid for all parts of the body, independent from size of electrodes, air space and position.

Figure 1 shows the result in the form of a graph. At the abscissa we have marked the damping values in which the distance between two points corresponds to a "ten" group. At the ordinates are drawn in the average values in watts, which differ for the three stages of heating. If one connects the points corresponding to each stage of heating by a line there will result three curves. Curve 1 designates those heating dosages which produce a perceptible sensation. Curve 2 shows the dosage for a moderate and curve 3 for intense heating. When one has established the damping for a definite treatment, the required dosage in this case can be immediately read off. Depending upon the intensity of the heating one desires, one will follow the curve 1, 2 or 3.

Our method of dosage is based solely upon the damping which is produced by the subject in the therapeutic circuit. Inasmuch as the damping embraces at one and the same time all the external conditions concerned with the treatment, that is, the size and shape of the treated bodily part, the size of the electrodes and their spacing, we are made independent of these factors.

This principle of dosing electric energy has so far not been employed in short wave therapy. It is only this simple relationship between damping and dosage we have found, which made possible the utilization of Mittelman's method for actual therapy. To be sure there is another technical difficulty to be overcome. The dosage data seen in figure 1 are based on damping values which we have designated by the figures 1 to 90. These empirically determined numbers hold good only for the particular short wave generator we have used. If the figures are to have any meaning to another physician, we must be able to measure the damping by a definite scale. It is only when we have an absolute measure for the damping that we can

have an exact mutual understanding. It is therefore necessary to establish for the damping a generally applicable unit, such as we already possess for wattage. We are at this time occupied with the definition of such a unit for comparison which can be easily reproduced at any time. All short wave dosimeters could then be calibrated according to it.

Technic of Dosimetry

The application of a treatment by dosimetry is not difficult. First of all the electrodes are arranged as required for the individual treatment without, however, the patient being between the electrodes. It is not necessary to arrange the electrodes on the patient and then to remove him from the circuit. It suffices to place the electrodes approximately at the distance one may presume will be needed for a given treatment. If one should err by a few centimeters it is of no practical importance. The empty circuit so established is then attuned to resonance. That done, the part to be treated is placed into the electric field and another tuning made. This will reveal a reduction of the tension (damping). The amount of the reduction of the tension is read off, and the number so determined is fixed on the scale of the regulating resistance meter. By turning of a switch the tension meter is now transformed into an instrument which indicates the energy in watts introduced into the body of the patient. On the basis of the read off damping we can obtain from the curves in our figure 1 that number of watts which is needed for minimal, moderate or intense short wave heating.

It is important that the attunings of resonance should be made exact both with an empty and an occupied field, for it is only when the damping has been determined with precision that the dosage is correct. The tuning to resonance requires a little practice and dexterity, but is not difficult to acquire. Once one masters it, the measurement requires only a very brief time. We have tested the method on numerous patients and have definitely established its clinical usefulness.

Summary

We have presented a method which makes it possible to determine the dosage for the treatment with short waves in the simplest manner. This takes place on the basis of the reduction of tension or the damping created by the patient in the electric field.

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UNDERGRADUATE EDUCATION IN PHYSICAL THERAPY *

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and

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Much has been said and written in recent years concerning undergraduate, graduate, and technical education in physical therapy. The Council on Physical Therapy of the American Medical Association, both collectively and through individual members, has done much to clarify this situation. It is the purpose of this paper to present a plan for undergraduate teaching in physical therapy which places this subject on a par with the teaching of pharmacology.

In 1908, the American Medical Association through its Council on Medical Education formulated a model curriculum. The curriculum committee, consisting of one hundred leading medical educators, allotted sixteen hours to the teaching of non-pharmaceutical therapeutics in the third year and fifteen hours to the teaching of electrodiagnosis and therapeutics in the fourth year. In 1916, Eggleston¹ found considerable attention being given to non-pharmaceutical therapeutics; in fifty-seven medical schools the average time devoted to these subjects, including dietetics, was sixty-two hours. In all but two or three schools special work was devoted to non-pharmaceutical subjects. Seventeen schools gave special courses in hydrotherapy and eleven combined hydrotherapy with some other non-pharmaceutical subject. At the time the problem was reviewed there seems to have been no uniformity of teaching methods or curricula in physical therapy.

Between 1916 and 1930, in spite of its increasing popularity, the teaching of physical therapy seems to have waned, because in the latter year we find the Council on Physical Therapy² advising a minimum of thirty-two hours of instruction. In 1936, Lowry³ found it a required course in fifty-six of sixty-six medical schools and only one school which gave no instruction in the subject. The average number of hours of teaching in these sixty-six schools was ten, only one-third of the time recommended by the Council on Physical Therapy. Lowry found, however, that while only 38 per cent of schools gave physical therapy as a required course in 1931, 56 per cent gave it as a required course in 1936. Therefore, although education in this field is far from the ideal, yet progress is being made owing to the efforts of the American Congress of Physical Therapy and the Council on Physical Therapy of the American Medical Association. The foundation which is being built is an enduring structure, since it has the support of these national organizations.

Premedical Education

The Council on Physical Therapy² has emphasized the importance of giving a medical background to the study of physics for premedical students. Perhaps a special course in biophysics should be provided and required of these students. At least special attention should be paid to the

* From the Department of Pharmacology and Therapeutics, College of Medical Evangelists, Loma Linda and Los Angeles, California.

² Read at the Seventeenth Annual Session of the American Congress of Physical Therapy, Chicago, September, 14, 1938.

relation of heat, radiation, electricity and sound, to medicine. We are not impressed by the present premedical preparation of students in the application of physical principles to the medical sciences. We have recently furnished the premedical schools, from which the majority of our medical students come, with memoranda of the needs of these students in preparation for their work in physical therapy.

Preclinical Teaching

In recommendations by the Council on Physical Therapy² and by individual authors,⁴⁻⁵⁻⁶⁻⁷⁻⁸ the statement is repeatedly made that the instruction in physical therapy should be largely clinical. It seems from perusal of the current literature that undergraduate teaching in the medical schools is almost entirely clinical. If, as mentioned above the average time is only ten hours, then by all means the teaching should be strictly clinical. If on the other hand, time is available, didactic and laboratory study in the preclinical years seem desirable.

In preparation for the clinical use of drugs, medical students in American medical schools receive 160 to 170 hours of didactic and laboratory study in pharmacology. They are taught in a most thorough and sometimes minute way the pharmacodynamics of over a hundred drugs. Many of these they will never use in the practice of medicine. Having spent several years teaching 168 hours of pharmacology per year, we are satisfied that a few hours of this time could be well spent in the study of the physiological action of physical agents. If these agents are to be used in the treatment of disease, why is it not just as important to present their physiologic action by means of didactic and laboratory study as it is to present the study of the action of drugs by the same means?

We have found but two references to the teaching of physical therapy in the first two years of medicine. Eggleston¹ in 1916, urged that a laboratory course similar to pharmacology be given in these years. Peck⁹ in 1931, suggested a short required course in the sophomore year followed by elective courses in the senior year.

In 1920, in the Department of Pharmacology of the College of Medical Evangelists, there was begun an experimental course in physical therapy in the second year. This was a new effort and required changing from year to year in order to develop experiments suitable for student work and class demonstration. At present this course offers twenty-seven didactic hours, nine for clinical demonstration, and thirty-six for laboratory study. We still teach 162 hours of pharmacology.

The didactic work covers the following subjects: (1) A brief history of physical therapy. (2) The Council on Physical Therapy, its work, and rules of procedure. (3) The place of physical therapy in medicine. (4) A review of the anatomy and physiology of the skin as related to physical therapy. (5) Physiologic effects of heat and cold, both local and general. (6) Physiologic action of the various hydrotherapeutic procedures. (7) Climatology, clothing and housing. (8) Therapeutic exercise and muscle training. (9) Occupational therapy and rehabilitation. (10) Massage, manipulation, and mechanical procedures. (11) Electrotherapy and electrodiagnosis. (12) Radiation therapy, except x-ray and radium. (13) Fever therapy. (14) Electrosurgery.

The following are the more important of the laboratory studies, some of which are done by the students in groups, and some presented as class demonstrations: (1) Reflex effects. (2) Effects of thermal stimuli upon metabolism. (3) Study of artificial fever. (4) Effects of physical agents

on the capillaries. (5) Electrolytic effects of the galvanic current. (6) Heating by thermic applications. (7) Contractile effects of alternating and direct currents. (8) Reaction of degeneration. (9) Study of the physics of spark gap and short wave circuits. (10) Heating effects of diathermy currents in animals and in the human. (11) Demonstration of electrosurgery. (12) Spectral study and measurement of radiant energy. (13) Cutaneous effects of radiation. (14) Bactericidal and biologic effects of ultraviolet radiation.

Following this course the student enters his clinical years with an appreciation of the fact that the physiologic functions can be influenced by physical measures as well as by drugs, since he has had an opportunity for comparison. During this second year to stimulate interest, a semi-monthly clinical demonstration is given by means of actual patients or by means of case records.

Clinical Teaching

We give no physical therapy instruction in the third year except such as the student gets incidentally in his clinical contacts. In the fourth year the students in groups of six spend 12 two hour periods in the physical therapy clinic where they actually give treatments of all types or observe them given. This year at three periods each week, an attending physician will be present for clinical instruction. Each Wednesday there is held a departmental conference for the benefit of the whole physical therapy staff, technicians, medical students, and student nurses. At this conference some interesting subject is presented and discussed.

There is no clinical didactic instruction in physical therapy as such in the senior year. The situation is such in our school, that the head of the Department of Pharmacology and Therapeutics teaches the course in general therapeutics. In the discussion of the treatment of various diseases, all possible lines of treatment are considered and an endeavor is made to give each therapeutic measure proper emphasis in the patient's program. This makes for a balanced presentation of the broad field of therapeutics. It also assures adequate consideration of physical measures in the treatment of every disease discussed. For example, we believe that physical therapy is of value in the treatment of many pneumonias; however, in some of the lobar pneumonias, especially type I, the effect of serum is so dramatic that all other treatment is of minor importance. It is recognized that such a program would not work out in all schools. If a student manifests a desire to do elective work in the physical therapy clinic, he is given every possible encouragement.

Research

Physical therapy is full of interesting research problems, both physiologic and clinical. In our department we are endeavoring to promote both. In the physiological realm, we have been working for a number of years as time allowed upon the effects of heat and cold upon the human circulation. In the clinical field our endeavor is to promote cooperative effort with other clinical departments. At the present time with the Department of Otolaryngology, we are conducting a study of the treatment of chronic purulent otitis media by means of short wave diathermy. With the Gynecology Department, we have recently started a study on the treatment of pelvic inflammatory disease with diathermy. With the Medical Department, we are beginning a study of the treatment of peripheral vascular disease with intermittent venous occlusion. Fever therapy also suggests many problems of a research nature. We shall endeavor to control these studies adequately, so that conclusions, when once reached, will be valid.

Summary

1. Although the number of hours devoted to physical therapy in the medical curricula is not large, practically all the medical schools have elective or required clinical courses.
2. It is highly desirable to stress the medical relationships of physics in the premedical college years.
3. It seems important that a fundamental physiologic foundation be built for clinical physical therapy in the sophomore year of medicine by means of didactic and laboratory instruction as is done in pharmacology.
4. Both physiologic and clinical research in physical therapy are essential to scientific progress in this field.

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Discussion

Dr. William H. Schmidt (Philadelphia): I was very much impressed with the essayists' schedule of teaching of physical therapy. It is unfortunate that to date there are very few schools which provide opportunity to present as much material as they are able to give their students. I am afraid that with the overcrowding of the curriculum in most medical schools there will be very few that will ever obtain the many hours of study provided at Loma Linda. I should, however, like to point out that a lot of the fundamentals should be and are actually obtained in the premedical course, such as biophysics, electromechanics, electrophysiology, and the like. Those teaching the subject of physical therapy today and who have been teaching for years cannot help but be impressed with the marked change which has taken place in the attitude of the medical students toward physical therapy. A few years ago where courses were elective it was difficult to get the students to attend the classes, but today we find no difficulty at all. The classes are well attended and the students show a marked interest in the work, and, as a matter of fact, a man teaching physical therapy has to be on the alert because they can ask him questions that may sometimes be embarrassing if he does not know his subject.

Many of these young students have spent time in hospitals and various other places where they have seen physical therapy used and where the work is carried on in a scientific manner, and very frequently in the senior year these young men know considerable about the subject of physical therapy.

The more time you can get to teach physical therapy the better it will be. At the present time in many of the schools the course is elective, and I think if we can secure a required course in all the schools that is the ideal to strive for for the next few years to come. I believe that the present attitude of medical students and the demand for the teaching of physical therapy will do more than anything else to put this subject into the medical curriculum on the proper basis. I hope, although I never expect to see the day, that we will all be able to teach physical therapy with as many hours at our disposal as Moor and Dail have been provided.

Dr. William Bierman (New York): This subject is one of fundamental importance to us because the attitude of the profession at large toward physical therapy is predicated upon the teaching which the undergraduate medical student receives while in college. It is not at all strange that physical therapy today does not hold as great a re-

spect as it merits, and I think that is essentially due to the fact that the undergraduate medical student has not been impressed with the subject because his teachers have not spoken to him about it. He has not adopted a respectful attitude inasmuch as when references have been made to the subject the references haven't been always very laudatory, and so any man who has the opportunity of fashioning the medical mind in the one place it can be moulded most readily is doing a great deal for physical therapy at large. We, therefore, should feel indebted to Drs. Moor and Dail for the development of what is, as far as I know, the most comprehensive course in physical therapy given in any medical school anywhere in the world.

Dr. Moor has an exhibit at this meeting and at that exhibit you can appreciate to a little greater extent than you can from this presentation which he has made here tonight that he has expended a great deal of thought and effort in the development of his course of physical therapy teaching at his college. I am particularly impressed because I think that one of the most important ways of conveying information is with the frequent use of motion pictures to illustrate the ideas which he attempts to convey to his students.

At the New York University Medical School, where I have the opportunity of attempting in my small way to fashion the minds of the future practitioners of medicine, we are required to give a course of nine or ten didactic lectures to the students during the third year. During the second year they have an elective in biophysics. In the fourth year they are offered an elective in clinical physical therapy. Those who choose this elective spend an entire month with me and my associates, either in the wards of the hospital which I attend or in the outpatient department. I think that is an example of instruction given in medical schools which is beyond that ordinarily presented in most medical schools.

Perhaps it might be of advantage to all of us who are teaching in medical schools to compare notes as to techniques which we are employing, and if possible to exchange illustrative material, lantern slides, charts, or motion picture films, inasmuch as that portion of the curriculum devoted to physical therapy is still in a very definite state of flux.

It occurs to me at the moment that one of the future activities of this Congress might well embrace an effort at coordinating the material which is now available for instructors in medical colleges. I think when we each individually have to feel our way,

we are bound to go much more slowly than we would if we could each benefit from the original angles developed by different individuals teaching physical therapy in the different medical schools.

Dr. Frank H. Krusen (Rochester, Minn.): It is encouraging to note such improvements in undergraduate teaching. Dr. Bierman's course is a distinct advance over the courses that were offered a few years ago, and I know that Dr. Schmidt has an excellent course at Jefferson Medical College, and there are many more courses now being offered which are a considerable improvement over those previously offered. I pointed out in a paper on this subject a few years ago that as far as the curriculum makers of our medical colleges are concerned, we have a vicious cycle. When the student of today graduates and starts to practice he becomes the curriculum maker of the future, and he in turn continues this cycle of neglect of particular subjects since he knows nothing about physical therapy. So that ignorance of the need for physical therapy is passed on from one group of curriculum makers to another.

We, of course, also need more knowledge of the fundamentals of physical therapy in our premedical courses. Most of the physics courses which are taught today are not the type that a medical student should have. They are prepared for engineering students. I was pleased to hear that the essayist had sent to the various schools from which his students are drawn an outline telling what they should have. I think that is a distinct step in the right direction.

I have one further suggestion, that is, if any of you have contact with the curriculum makers of the Association of Medical Colleges, use your influence to get them to modify the curriculum. There is a Committee on Medical Curriculum of the Association of American Medical Colleges which has dictated the standard curriculum for medical schools. Dean Cutter, of Northwestern, has spoken of changes that should be made in this course before that Association. I read a paper before them a few years ago, urging them to change their curriculum, but to date they have not changed their recommendations. However, many of the deans have made certain progressive changes in their own curriculums, and because of the demand have offered hours in physical therapy, although they are still not suggested in the standard curriculum of the Association of American Medical Colleges.

VALUE OF EXERCISE IN CONTROL OF POSTURE *

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When we speak of the "value of exercise in the control of posture," we mean by "posture" the positions which the body assumes in all of the activities of the day. Good posture for which we strive is not a stiff standing position nor a military walk, but an attitude of ease and grace for every occupation, which enables the muscles and levers to work with the minimum expenditure in energy.

As the child grows and learns to walk and balance its body on its small base of support, its posture in the upright position will be good only if all of its muscles are developed normally in proportion. As the anti-gravity muscles and those of balance are the ones more involved in the upright posture, they need the opportunity to develop strength and what is equally as important, the skill to adjust the body so that it is easily balanced and the segments properly related in order that organic and muscular functions can proceed normally.

Training in Childhood

The environment of the child of today does not encourage an all around development of the skeletal muscles or skill in balancing the body, therefore the problem of posture improvement and control is present from the earliest walking days. Restricted play opportunities with no need to balance on rough or narrow footing, to climb and reach and suspend the weight by the hands all prevent the great extensors of the upper back and shoulders and the balance muscles from developing proportionately. Much sitting in soft, disproportionate chairs and stooping over play and work occupations, walking on smooth surfaces, all in too restrictive clothing set the neuro-muscular pattern for the poor posture in the little child and increases the problem during the fatigue of adolescence.

The value of exercise in attacking this problem is three-fold.

Prevention of postural defects through opportunity and incentive for vigorous and all around play during childhood and young adulthood would be ideal and desirable. For the posture problem patient this same type of exercise is valuable for the toning up of all the muscles of the body so that it may better withstand fatigue and avoid some of the "fatigue slumps".

Another value is the actual strengthening of the anti-gravity and balance muscles through repeated exercises which tend to restore the muscle tonus in those that have been stretched and relaxed by the poor posture.

Then there is the important improvement in circulation and respiration which are the results of exercise and are probably of greater significance than mere increase in muscle size and strength.

But the most important use of exercise is for the effect on the neuro-muscular mechanism. "Posture is one of the expressions of neuro-muscular habits,"¹ "The mind, the emotional substrate, is reflected in posture, but many vital factors which bring about posture, work quite below the

*Read at the Seventeenth Annual Session of the American Congress of Physical Therapy, Chicago, September 12, 1938.

threshold of consciousness."² The sub-cortical centers of synergic co-ordination, balance, muscle tonus and automatic movement develop definite pathways of response to the outward stimuli of gravity and loads and the inward weights and pressures of the body. "Habit is the result of repeated training of neuro-muscular pathways."¹ The proprioceptors and the motor nerves to the muscles with the myriad of secondary neurons between set up these pathways early in life to perform the early, fundamental movements and these affect the other, related neuro-muscular habits that develop later. Thus, if a child has the habit of "toeing in" with one foot while walking, that foot will tend to toe in when the skill of skipping and jumping is acquired.

In assuming the upright posture the neuro-muscular mechanism early establishes habits of extension and balance which gradually change as the center of gravity and size of the base of support change with the coming of adulthood. Other factors which modify these habits are changes in weight and the proportion between length of levers and the size of the vital organs. Thus, the little child with short levers and large abdominal organs has a normally different posture with more lumbar lordosis than the tall, slender young adult. If during the formation of the neuro-muscular routes the pattern makes for poor posture then there is a habit of poor posture which will enter into every attitude and interfere with the efficiency of some of the movements of the body.

Because most poor postures are the result of incomplete extension or partly relaxed anti-gravity muscles and poor balance, the muscles involved must be taught new habits as well as strengthened. "The muscles, which co-operating determine posture are not ordinarily under voluntary control, but by proper training one can become aware of them and learn to control them. This training consists of *doing* certain movements and observing the accompanying sensations and then to utilize and control these sensations to produce the desired movements, thus to control posture through the development of neuro-muscular patterns"². In kyphosis for example, the extensors of the back, especially the upper back are directed consciously to contract more than usual; the sensations of the new position resulting are observed through the proprioceptors from joints, ligaments, muscles and internal organs in the trunk; repetition confirms the sensations and then the patient seeks to repeat the sensation, which seems easier than to consciously contract the muscles. After the "feel" of the movement and position has been learned, repetition establishes the *habit* of the position. Through repeated doing and thinking any new skill or habit is acquired and this "doing" is the "exercise" which helps to control posture. It is not necessarily "hard" exercise although the habit seems to come more quickly if there is moderate effort involved, but the exercise to be effective must have its purpose and hoped for result must be clearly understood by the patient so that the voluntary centers may do their part. To more easily comprehend the exercise and its results visual aids are valuable. Photographs and mirrors which show the patient how his posture looks as compared to an ideal and which help him to see the result of the change in posture in appearance, stimulate the psychic centers and through memory centers repeat this stimulus.

Exercise performed in front of a mirror is more valuable for the same reason as well as speeding up the learning process. Accuracy in technic and the elimination of faulty positions in other parts of the body may be watched for and guarded against if the patient can observe the exercise in a mirror. Suppose we observe the patient with kyphosis as he does an exercise for strengthening and re-educating the shoulder retractors. If care is not taken his head will move too far forward and a lumbar lordosis will appear. This

commonly occurs when a child is told to stand up straight and stick out its chest, without any chance to see the results or feel the correct position. Away from the mirror in any situation the memory of the sensations and the accompanying improvement in appearance help to repeat the adjustment until it becomes a habit.

Motor learning consists largely of conditioning reflexes and as Pavlov has said, repetition "fixes" the response. Repetition of movement constitutes exercise and conditions the reflexes of posture so that there is better poise and ease of movement in all activities.

In an experimental group of young women students at the University of Wisconsin selected because of poor posture, 83 per cent improved to such a degree in three weeks' time that the strengthening of the muscles involved could well be discounted. The nature of the exercises was such that the improvement in posture must have been due to re-education or reconditioning of the neuro-muscular pathways. Usually it takes longer to acquire a new skill, but the incentive and the concentrated work incidental to an experiment made this speedy improvement possible.

Re-education By Exercise

The procedure in this re-education by exercise in the experimental group is as follows: To eliminate stimuli from the proprioceptors concerned with the upright position the patient lies supine and relaxes as much as possible. Usually some muscles have to be trained to relax, and if those that are to be re-educated do not relax, then that must be a part of the first lesson. The extensors of the lower back and the pectorals and upper trapezii are frequently over tense, being accustomed to a contracted position in the hollow-back and forward-shoulder upright posture. With the hand of the patient on his chest and neck to feel the texture of the muscles he is encouraged to "let go" and notice how soft they become.

Moving the shoulder back toward the floor may relax the muscles under the patient's hand through the synergic reflex. One hand of the patient then is placed on his abdomen and one under the lumbar region, and he is told to observe the change in the feeling the muscles have while he presses the lower back against his hand and tries to squeeze it against the floor. Inasmuch as this is an exercise for the abdominal muscles he will feel them harden as they contract, and his attention is called to the movement of the pelvis which accompanies it. After experiencing this contraction several times, he is directed to remove the hand from the abdomen and produce the movement of the lumbar region and observe the sensations in the abdominal muscle through proprioceptors. He then is directed to repeat the sensation of abdominal contraction many times. In the same way the gluteal muscles are observed by the finger tips and then through the kinesthetic sense during contractions and relaxations. These two groups of muscles are next exercised simultaneously while the patient observes the pelvic tilt which results. As he lies on the back the lumbar region is highly arched and then the movement of tilting the pelvis to flatten the lumbar region is repeated. In this exercise he learns the feeling of the muscle contractions and movements which control the pelvic tilt.

With the patient lying on his face, the arms are extended to the side in line with the shoulders and lifted free from the floor. In this manner he learns the feeling of contraction in the middle trapezii and rhomboidei muscles for the replacement of his forward shoulders. The resistance to the muscular effort in these three simple exercises is so small that the actual strength of the muscles is very slightly increased. With the patient on the back again he repeats the pelvic tilt holding the position with the muscles

contracted while he repeats the sensations of the contractions in the shoulder retractors. Holding these three muscle groups tense he is instructed to remember the feeling. After this has been repeated a sufficient number of times to make further experimentation worth while, the patient then stands in front of a mirror and is instructed to imagine that he is still lying on the floor on his back and then told to contract those three muscle groups and experience the same sensations as before. In the mirror he will observe the movement which results and under the direction of the instructor will produce just sufficient movement to bring his body segments into line so as to conform with the ideal for his body build. This body adjustment is repeated under observation until it needs no further supervision, at which time the patient is ready to repeat the sensations without looking in the mirror and then to observe the results by glancing in the mirror or by having a photograph taken.

In this manner other muscle groups were re-educated and the results tested until all of the students learned what their posture defects were and how to correct them through experiencing the *feeling* of the correct posture. For three weeks, three times a week, forty minutes at a time, the students did these exercises with the result that 83 per cent were satisfactorily improved in their posture. None of these students had extremely weak muscles or badly contracted opponents to any of the anti-gravity muscles, and no experimentation was done on cases of scoliosis because such students were given exercises in the regular individual gymnastic classes which would strengthen, stretch opponents as well as re-educate the muscles at fault. I have emphasized the importance of the educational value of exercise as compared with the strengthening value, because so often when exercise is suggested as a means of learning to control posture, the physician in charge of the case visualizes a gymnasium full of horses, parallel bars, rings, and heavy dumbbells and tries to imagine his frail, asthenic, stoop-shoulder patient working vigorously among these things and shudderingly decides against it.

Summary

1. Posture in the child will be satisfactory only if all the muscles are proportionately developed.
2. Posture in the adult is apt to be poor because of early poor neuro-muscular habits and fatigue.
3. Exercise improves muscle tone generally and specifically in the anti-gravity muscles.
4. Exercise improves circulation and respiration throughout the whole body so that fatigue is more readily withstood.
5. Exercise can be used to develop new neuro-muscular habits related to posture control.

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Discussion

Dr. F. H. Ewerhardt (St. Louis): It has been a long time since I have heard an exposition of the value of teaching good posture through the training of the various sensory impressions, especially muscle, joint, and balance sensibility. For many years it

has been thought that poor posture was primarily the result of weak muscles. That this is so may be attested by the fact that many of our athletes who are endowed with a strong musculature have very poor posture. Consequently posture education was primar-

ily directed towards strengthening muscles. It is interesting to note that during the last twenty-five years relatively little has been accomplished in the public schools from the standpoint of improving posture. We know this to be true when we compare the statistics of university students of twenty-five years ago with those of the present day. Dr. Denniston has emphasized the importance of teaching good posture through the neuromuscular apparatus. This does not mean that the development of muscles should be disregarded. It is essential that weak muscles must be strengthened and the short ones lengthened. Dr. Denniston has stated the value of all around play as being desirable.

Dr. Kristian G. Hansson (New York): We have just listened to probably the most up-to-date paper on the present conception of postural position. Those of us who have been interested in the problem and can go back twenty-five or thirty years can easily visualize the changes in ideas as to posture. Some twenty-five or thirty years ago the idea of posture was mainly concerned in muscle strength and its development. It was mostly taught and practiced by muscle conscious men of little learning. The second development I believe is in the study of primitive postural reflexes, and thirdly I believe we are going through a different attitude, that is, what you might call a psychological attitude toward posture as represented by the consciousness of our posture sense.

When I read the title of the paper, "The Value of Exercise in the Control of Posture," I stopped in the middle and my idea was to discuss the value of exercise or the value of posture exercise. That brings out a thought that is really not a criticism of the paper but is an addition that I should

like to make, namely, that we should not think of exercise entirely for the production of a certain appearance or external appearance of the body, but of value to the patient's health. The value of exercise in the last analysis should be determined in terms of effect on the circulatory system, the lungs, the heart, the gastrointestinal tract, and the like. So that the posture itself, which is an impression we get on the retina, should be guided by the effect of such posture on the child's health.

I have been interested for ten years in trying to find some fundament on which to base the value of exercise to the health, and I have been utilizing the vital capacity of the lungs as criteria of children's health as they improve in their general appearance. Dr. Denniston has touched all the important points of our present conception of posture.

Dr. Helen Dobson Denniston (closing): I thought perhaps in the discussion there might be some question as to how we know there was improvement in posture. In these days of statistics and the big question mark of "how do you know when you have done a good job," we have to have proof. We have an objective method of grading posture. We do not depend upon opinion. We have a scale of posture grading into which each student's record must go and come out good or bad. It is not opinion but figures which we find very helpful because we can quote them to the students and not have them think almost out loud, "What do you know about what good posture is; you are so out of date probably your ideas are not at all modern?" Well, we have figures that we can show. All of our measurements are objective, so that we do not have to apologize for an opinion.

MANIPULATION IN LOW BACK CASES *

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Manipulation has been used for many years with relatively gratifying results in some cases of low back pain. The explanation for these beneficial effects may have been scientifically unsatisfactory, but there remained the fact that cases having a more or less typical history and group of physical findings were greatly benefited by certain manipulative movements. It is a peculiarity of those practicing physical therapy to feel the necessity of explaining, on a theoretical basis, the how and the why of the results obtained by the use of physical agents, when, in the fields of biotherapy and chemotherapy, the biochemists and pharmacologists do not feel this need so keenly. They simply state the average reactions of individuals to various doses of their agents. If an explanation is available for these reactions, all well and good, but explanation or not, when we wish to obtain those reactions we use a dose which, in the average person, will produce the desired

* Read at the Seventeenth Annual Session of the American Congress of Physical Therapy, Chicago, September 13, 1938.

effect. Perhaps if we were to apply the same methods to the study of physical agents and expect that scientific explanations for their action would be forthcoming in the future, we could more easily add them to our armamentarium and make legitimate use of them instead of permitting them to become the means of various cults. Our duty is to evaluate the effect of physical methods and to use them as therapeutic agents where indicated, irrespective of their theoretic basis.

Manipulation is usually restricted to those cases which may be managed without anesthesia and in which the pathologic process is slight. It is a method of returning to normal position, alignment, and mobility parts which are fixed in a slightly abnormal position as a result of their being carried somewhat beyond their normal range of movement. This results from the application of a force either of great intensity, or in an unaccustomed direction, or a combination of both.

This definition of manipulation naturally limits its use to those cases in which the pathologic process was caused by forces carrying the joint slightly beyond its normal range of movement and requires that cases for manipulation be carefully selected. A complete history and a thorough physical examination are necessary to eliminate possible sources of low back pain from pelvic or abdominal disturbances. A complete x-ray examination must be done to rule out the possible presence of destructive or proliferative skeletal involvement. Frequently the radiographs show the same pelvic tilting and lumbar scoliosis that are found on physical examination.

The typical history of those cases of low back pain most amenable to manipulation is that the patients have slipped or stumbled and actually fallen, or just caught themselves from falling, or they have lifted something heavy or in an awkward manner. The complaints are pain in the lower back usually localized over one sacro-iliac joint and pain radiating down the leg either anteriorly or posteriorly. There is also limitation of movement in the lower back and frequently the movements are slow and cautious. The condition may be acute, but some cases of long standing are proper subjects for manipulation.

Method of Examination

The technic of examination and the physical findings vary, but the following examples are rather typical. The patient is undressed so as to expose the back and is asked to stand up, with shoes on, heels together, arms down at the side, in a relaxed erect position. The back is inspected for evidence of scoliosis, kyphosis, or postural defect. Usually some scoliosis is seen which is probably secondary to a tilted pelvis. The area over the sacro-iliac joints and along the lumbar vertebrae is palpated for muscle spasm and tenderness. Standing back of the patient the relative position of the crests of the iliae is determined by placing the medial border of the hands on either crest and sighting their relative position. One crest may be found to be higher than the other. The patient is then asked to lie down on his back and the relative length of legs is obtained by placing the forefinger of either hand firmly against the internal malleoli and noting their positions. Usually the side with the high crest will correspond to the side with the shorter leg. When this is otherwise, the positions of the crests have been reversed on lying down from what they were in the standing position and indicate some lumbar rotation. This can be checked by measuring the position of the crests in the supine position. For this mensuration it is assumed that the two sides of a normal person are symmetrical which we know does not always obtain, but the measurements are valuable as a diagnostic aid and determine the manipulative movement to be used.

Mobility of the sacro-iliac joint may be tested by placing the patient on his stomach and subjecting the distal portion of the sacrum to a downward force while palpating the joint. Normally the degree of movement is the same on both sides.

The findings of localized pain, disparity in the height of the crests of the ilia and in the length of the legs indicate the presence of some sacro-iliac lesion. Other tests may be used, such as the Patrick "fabere" sign.

Method of Manipulation

Preliminary to manipulation radiant heat or short wave diathermy and deep massage are applied to the muscles of the back to obtain their relaxation. Simple rotation of the thigh is an effective method of manipulation in about 40 per cent of the cases. For an anteriorly rotated ilium with a low crest and a long leg our aim is to rotate the ilium posteriorly. This may be done by grasping the leg in one hand and the knee in the other hand and rotating the thigh inward, upward, outward, and downward several times, each time slightly increasing the arc of rotation. For a posteriorly rotated ilium with a high crest and short leg the thigh is rotated outward, upward, inward, and downward. After the rotation the length of the legs is checked and a final check is made with the patient standing.

Cases which do not respond to the above technic are treated as follows: The patient is asked to lie on a table on the unaffected side facing the physician. The legs are semi-flexed and the top leg is allowed to hang over the edge of the table. The top arm is placed back of the patient. Pressure is then applied to the posterior spine of the ilium if anterior rotation of the ilium is desired or to the spine of the ischium if posterior rotation of the ilium is indicated. Counterpressure is applied to the top shoulder. A short, quick thrust, which need not be extremely forceful, is applied at the end of the stretching movement. Frequently one can feel the movement of the parts which is sometimes accompanied by a sharp sound; however, this is not essential for correction.

Usually the acute type of case which can be manipulated within 24 hours will get immediate relief. On others the manipulation will have to be repeated several times. Some may be corrected easily but do not stay corrected. These should be strapped with adhesive plaster or put in a sacro-iliac belt after correction.

Pitkin and Pheasant in the *Journal of Bone and Joint Surgery* for 1936, and January, 1937, give an excellent review of the probable pathologic process present in these cases. The normal sacro-iliac joint has a rotational movement of 4 to 6 degrees. There is also some rotation possible at the symphysis pubis. The ilia may move together in relation to the sacrum as they do in the normal movements of bending forward or backward, or they may move oppositely in relation to the sacrum as they do in tortional movements of the trunk. The acetabulum is located anteriorly to the axis of rotation passing through the sacro-iliac joints, and thus when the ilium is rotated anteriorly the leg is lengthened on that side, while if the ilium is rotated posteriorly the leg is shortened. These movements and positions are all normal and when the forces causing them are removed the parts return to a normal symmetrical neutral position. When the parts do not return to the neutral position then the normal mobility of the joint is lost and an unnatural strain is put upon the supporting ligaments and tendons resulting in pain, both local and referred to the corresponding segmental areas of greater sensitivity.

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PHYSIOLOGIC CONSIDERATIONS OF ARTIFICIAL FEVER THERAPY *

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In considering the well-being and safety of the patient subjected to fever, induced by physical means, we have directed our attention not so much to the successful management of emergency reactions but rather to the preparation and his care in order to avoid serious critical complications. Our attempts in preparatory and supportive treatment have been such that the patient is kept as near his physiologic normal state as possible during hyperpyrexia. Some of the important physiologic observations regarding the fever patient are worthy of our attention.

The heart is required to carry an extra load throughout the hours of fever. Our first responsibility is to determine whether or not the heart is capable of efficiently performing this extra work. There are many hearts which are rejected for fever treatment on the history and physical examination. However, there is a doubtful group which give little or no information on this phase but present definite warning on the electrocardiogram. The most common finding in our experience in this group has been a prolongation of the conduction time, indicating a partial or possibly approaching complete heart block. It is doubtful what may happen to such a timing mechanism under an increased load of work during fever; therefore hyperpyrexia is discouraged for such patients. We believe it advisable and take an electrocardiogram on every patient before beginning a series of fever treatments. The heart can be spared excessive work by giving special attention to the psychogenic factors which increase the pulse rate. The preferred method is the use of internal electrically induced heat rather than an external application of heat for creating fever, and an adequate hydration of the patient. The lowest pulse rate which can be maintained during fever is to be desired because it approaches the physiologic limit of efficiency, and therefore produces the least cardiac exhaustion.

Another routine preliminary practice is to determine the concentration of non-protein nitrogen and sugar in the blood. We have never had a patient with a non-protein nitrogen sufficiently high to contraindicate pyrexia, but we have frequently observed blood sugars ranging from 60-80 mg. per 100 cc. This degree of hypoglycemia does not contraindicate fever but must be kept in mind during the treatment to avoid the possibility of hypoglycemic shock. We have observed symptoms of hypoglycemia during fever even in patients having a fasting sugar level of 80-90 mg. When hypoglycemia occurs during fever most patients do not complain of hunger, which is usual in an afebrile attack. When an occasional patient complains of hunger we feed him. During this condition the patient exhibits an unusual degree of restlessness frequently accompanied by an anxiety or fear in spite of intake of sedative drugs. In all such cases we immediately give a glass of orange juice containing dextrose. Relief is obtained in about 15-20 minutes; the symptoms ameliorate or disappear. This can be repeated as required un-

* Read at the Seventeenth Annual Session of the American Congress of Physical Therapy, Chicago, September 15, 1938.

less the condition becomes severe; in such a case too much orange juice may produce an alkalosis especially if the patient has hyperpnea which may occur during hypoglycemia. In a severe case it is best to discontinue treatment and resort to an intravenous infusion of 10 per cent glucose in saline. In any unusual degree of restlessness a narcotic should not be given until hypoglycemia has been ruled out lest the patient go into shock while under the influence of the drug. It is not advisable to give glucose to all patients as a safeguard because those who do not need the sugar are usually nauseated by it.

The peripheral vascular bed is of special concern because collapse is apt to occur unless ways of avoiding it are constantly kept in mind. In this regard it is important to avoid impending shock due to either hypoglycemia or dehydration; drugs of the belladonna group are to be avoided; and internal electric induction of heat is preferred to external heating.

Experience has led us to believe that adequate hydration of the fever patient is essential and our present method is giving most excellent results. We believe it is as important to govern the fluid intake on the day before treatment as it is during the treatment. This is doubly important in a patient who has been on a vegetarian diet which is rich in potassium. The potassium favors the elimination of chlorides and the level of chlorides in the body under such conditions is usually quite low.¹ On the day preceding treatment we require the patient to imbibe two quarts of fluid in addition to the usual fluid intake; one quart of this is to be a nutrient hydrating solution made according to the following formula: sodium chloride 1.0 per cent, glucose 3.0 per cent, gelatine 3.0 per cent, flavored with beef bullion or tomato soup. This solution should be served hot and taken at the rate of about three to four ounces per hour; larger quantities tend to produce nausea. After this preparatory treatment we do not find it necessary to administer sodium chloride during the fever treatment; neither is any larger amount of salt required. During the fever the patient consumes about three to four quarts of water and about one pint of orange juice. With this method of hydration patients tolerate fever extremely well and have very little exhaustion even when a succession of treatments at a high temperature is given. This method has proved to be far better than when sodium chloride and water are given alone, regardless of amounts, time, or manner.

An additional observation regarding the prevention of dehydration during fever treatment is to use a cabinet in which the environmental temperature is relatively low, and the humidity is 90-100 per cent. The work of Gibson, Kopp, and Evans² shows that humidity is very important and that readings below 50 per cent greatly increase the reduction in plasma volume and the degree of dehydration. This is especially true if the air is in forced circulation. Under the latter condition marked dehydration may occur in spite of a liberal ingestion of fluids. The use of low air temperature and 90-100 per cent humidity even with forced circulation of the air, obviates much of the danger of increasing dehydration. Gibson, Kopp, and Pijoan³ have shown that the prevention of dehydration during the fever treatment is of greatest importance when hyperventilation occurs, because the degree of alkalosis which approaches critical levels is related to the severity of the dehydration and is dependent upon the extent of hyperpnea.

Physiologic Ingestion of Hydrating Solutions

It is pertinent at this point in our discussion to consider the physiologic advantages of the ingestion of this hydrating solution. This solution is well tolerated, easily assimilated, and non-irritating. Dutton⁴ states that gelatine solutions in slightly hypertonic saline state are indicated in fluid losses, in

dehydration, and in hypochloridation whatever the source. Also that the saline hypertonicity not only replaces the water and the salt, but conserves the mineral content of the blood above normal by reversing the osmotic currents from an outward to an inward flow. This solution will maintain the required level of tissue hydration. According to the work of Kugelmass and Bergren,⁵ gelatine is markedly hydrating and in combination with the salt, stabilizes the water absorption in the patient. The sodium chloride, a neutral salt, prolongs the retention of ingested water because of the hydration of the sodium ion and the neutral salt effect. In view of the absolute relation of this salt to the water content of the body we can be sure to restore to the blood and tissue their normal degree of hydration. These workers also determined that gelatine contributes to the concentration of the serum protein, which is directly related to the degree of hydration and can be used as a measure of the water metabolism. They state that the gelatine renders the solution colloiddally osmolar and its tryptic digestion favors a slowness of molecular absorption from the solution. They contend that this solution prevents the increase in acid constituents in the blood which occurs during dehydration and therefore prevents the development of a metabolic type of acidosis. This solution helps to prevent the shock apparently due to vascular dilatation with a relative deficiency in blood volume. By increasing the blood pressure the gelatine combats the lowered arterial tension which results from a decrease in plasma volume.

From a standpoint of nutrition the gelatine in this formula has decided physiologic advantages. According to Dutton⁴ gelatine is a protective colloid of the emulsion type; it contributes to protein requirement without stimulating peristalsis; it adds nourishment without straining a limited food tolerance; it is non-allergic; it does not lead to gastrointestinal upsets; it does not promote fermentation or intestinal irritation; and it has a very salutary effect upon infections in that it is a reliable antibody stimulant.

Gelatine is a very important food for the prevention of exhaustion and fatigue because it contains 25 per cent glycine, amino-acetic acid. According to Gibson and Martin,⁶ Brand and Harris,⁷ Thomas,⁸ and Barborka,⁹ this essential amino acid has the definite effect of increasing the strength of skeletal muscle, it acts on the metabolism of resting muscles in an important relation to creatine; and it acts as a tissue builder. Each 1000 cc. of the nutritious hydrating solution supplies about 8 Gm. of pure glycine, which is a generous dose for normal muscles. Since we have been feeding gelatine we have increased the well-being of the patient during fever and markedly decreased the fatigue and exhaustion following the treatment.

In addition to feeding gelatine, other factors regarding nutrition should not be neglected. When we give a patient fever we definitely increase his metabolism¹⁰, and it is our opinion that this increase is not an indication for starvation. It is a physiologic fact that the higher the metabolism the greater is the food requirement. We routinely insist that the patient eat a good breakfast at least one hour before the beginning of the fever treatment. In patients that have a low blood sugar we also advise eating a late lunch one hour before retiring the preceding night. It is our observation that patients do better during fever when given a good breakfast than when food is denied. During the height of the fever we provide orange juice. When there is a complaint of excessive hunger during the period of fever we give soft boiled eggs, toast and coffee without any untoward effects.

Elimination and Sedation

The physiologic function of elimination is also of importance. It is

our practice to give the patient an enema the night before treatment. Cleansing the large bowel is of advantage in that it obviates the possibility of absorption of large amounts of toxic fluids during the fever. Phillips¹¹ has shown that elimination through the sweat glands is enhanced by the use of internal electrically induced heat as compared to the effect of external heat. He contends that the physiologic function in the skin and subcutaneous tissue cannot be normal if the normal heat gradient is reversed. Neymann and Osborne¹⁰ have shown that drugs of the belladonna group which inhibit perspiration, should not be used. This principle is highly important because it may lead to uncontrollable temperature rise and collapse when disregarded.

We have heard much about the discomforts of fever therapy. The psychic irritability, emotional instability, and the physical restlessness produce poor physiologic economy and lead to exhaustion and fatigue. These disturbing symptoms should be controlled so that restlessness is reduced to a minimum and the heart muscle is spared.

In our experience we have tried many drugs including bromides, the barbiturates and their derivatives, and narcotics in varying dosages and combinations. Our present method of sedation surpasses any which we have tried previously and gives an ideal control of the patient. The effect is ideal because the patient is quiet but sufficiently wakeful to be cooperative. For sedation we give one or two hypodermic injections during an eight-hour fever curve. The first injection is given as soon as the patient begins to get restless, which is usually at the end of the first hour. Some patients are adequately controlled by a single hypodermic injection; this is especially true when rectal temperatures of 103-105 F. is attained. When a second injection is required it is given during the third or fourth hour. The hypodermic injection consists of papaverine hydrochloride gr. 1/3, Pantapone gr. 1/3, Atrinal gr. 1/60.* We do not recommend the use of papaverine and atrinal when external heat is used for inducing the fever. Atrinal is the sulphuric acid ester of atropine and can be used because it is devoid of the anti-diaphoretic action of atropine. The papaverine and atrinal cause a relaxation of all smooth muscle in the body and thereby reduces nervous tension. Pantapone is used in preference to morphine because it produces less untoward effects. Since using this sedative we have had no cases of persistent vomiting. To be sure, an occasional patient will have a single emesis during or following the fever treatment. The psychogenic factors are adequately controlled and our technicians do not find it necessary to coax, cajole, or use any other special methods of persuading the patient to withstand the treatment. We find no necessity of employing any special methods of distracting the patients attention from the treatment.

Summary

1. The heart can be spared (a) by aid of the electrocardiograph in selecting patients; (b) by the use of internal electrical induction to promote fever; (c) by adequate hydration of the patient before and during the treatment; and (d) by adequate sedation.

2. Blood sugar level should be known and special symptoms of hypoglycemia and impending shock recognized. These are easily relieved by the ingestion of glucose. Narcotics should not be given until hypoglycemia has been ruled out.

3. Peripheral vascular failure can be avoided (a) by employing internal electrical induction of heat; (b) by eschewing drugs of the belladonna group;

* One ampoule Spasmalgin to which Pantapone gr. $\frac{1}{3}$ is added.

(c) by avoiding conditions approaching shock; (d) by regarding adequate hydration as an essential part of preparation.

4. Adequate hydration is most important in the preparation of the patient for fever. We recommend the formula of our hydrating solution to be especially advantageous. Since its use we have not found it necessary to give intravenous or subcutaneous fluids at any time, nor to combat jaundice, pernicious vomiting, and the like. This formula is superior to saline solution regardless of the manner in which the latter is given. The tendency toward dehydration during the fever treatment can be minimized by the use of a cabinet containing air of relatively low temperature and high humidity.

5. We regard nutrition, elimination and sedation as important physiologic aids for the fever patient and our method highly satisfactory.

6. Fever treatments are well tolerated, by the method described, untoward effects are reduced to a minimum, and serious complications unknown.

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POSTOPERATIVE USE OF RADIUM FOR NASAL POLYPS

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For the past 14 years we have used radium in the postoperative treatment of nasal polyps. Experience with one case with very rapidly recurring polyps before we had radium available, led me to doubt surgery and caustics as the complete solution to the problem. In 1923, therefore, we began to use radium as a routine postoperative procedure in all types of nasal polyp cases. Since then there has been a gradual change in dosage of the radium and also in the choice of cases on which it has been used.

Postoperative use of radium for nasal polyps is no longer an experiment. It is sixteen years since Lyons¹ first tried it on polyps and found that it tended to prevent recurrence and also to reduce the amount of surgery needed. This was accomplished by the formation of fibrous tissue.

Our experience in about 60 cases, using a different technic, has also been extremely favorable. I have seen no reports that are unfavorable to the use of radium in nasal polyps. A review of the literature to date, shows there is a great lack of uniformity in the way radium is used by different clinicians. All are agreed, however, that radium reduces surgical intervention, and will, if carried over a period of time, completely eliminate nasal polyps.

When we first started to use radium, there was no information at hand what dosage to use and what screening method to apply. Radiologists at that time greatly feared over exposure especially to tissues adjacent to the orbit and brain. For this reason we started with 35 to 50 milligram hours repeated every 3 or 4 weeks. Finding that this did not slow up recurrence sufficiently, the dosage was gradually increased to 75 and then 100 milligram hours. Occasionally 125 milligram hours has been used. This amount has proven adequate in all cases treated.

No longer is it necessary to use radium postoperatively except in recurrent nasal polyps involving the ethmoid labyrinth, anterior and posterior. The polyps involving other sinuses can be dealt with by surgery alone. There is a definite allergic factor in these recurrent ethmoid polyps and because allergy is apt to be inherited, we find also not infrequently, an hereditary tendency to nasal polyps. One of my patients had a mother, two sisters and a brother all suffering from nasal polyps.

Complete removal of all polyps and degenerated tissue continues to be the first step in treatment. When radium is to be used, I find it is not necessary to do more than curet the ethmoid area and remove the larger pedunculated polyps which protrude into the nose. Smaller polypoid masses yield readily to radium and should they present into the nose later, can be easily picked off before the radium is again applied.

Dosage and Technic

The radium which we use is encased in monel metal tubes or needles of 0.4 mm. wall thickness. Radium sulphate is enclosed in platinum cells of about 0.1 mm. thickness within these needles. Each needle contains twelve and one-half milligrams of the radium salt. We use four of these needles, usually two on each side.

Radium rays may be divided into alpha, beta and gamma according to their penetrating power. Alpha rays are of low value and may be screened off by a thin piece of cardboard. It is the beta and gamma rays with which

we have to deal. An ordinary metal container used in cavity work will screen off most of the less penetrating or "soft" beta rays. "The hard rays are of extreme tenacity and it is doubtful if 1 cm. of lead will completely block them." (Newcomet).² "To get deeper effects the greater quantity of beta rays are cut off so that only gamma rays are employed. In such cases thicker filters are necessary, two mm. of platinum or four of lead or silver cutting off practically all of the beta rays." (Knox).³

The question, of course, arose whether we wanted the beta rays in this location, and if so, how much. Our decision resulted in using little screening, and therefore a shorter time exposure than used by men who have worked more or less independently on this problem. Our method besides saving time for both the doctor and patient, permits the application of a much smaller mass in the nose.

In dealing with a case suitable for radium, the question of allergy is gone into and appropriate treatment recommended. When surgery is finished, a few days are allowed to permit partial recovery of operated tissues. Four needles are used, each containing 12.5 milligrams of radium. Two needles are wrapped together in 0.5 mm. thickness of dental rubber after being attached to a strong anchor thread. Two needles so covered are then wrapped in a thin layer of absorbent cotton and placed under each middle turbinate after cocainization, and held in place by cotton tampons. The anchor threads are looped securely over the patient's ears. Using this method, more of the beta rays, both hard and soft, are utilized. Fifty milligrams of radium are left in the nose on the average of about two hours. This dosage is repeated at three to six week intervals until from five to eight treatments have been given. In no case has there been complaint of any ill effect other than an occasional feeling as of a fresh head cold.

Scott-Brown⁴ employs practically the same technic. He uses four needles on wire applicators and pushes them up into place, allowing the handles to protrude from the nose. Each needle contains 10 mg. of radium and remains in place six hours when it is then applied to the other side. This means 240 milligram hours to each side instead of the fifty which I use. He also does not screen the needles. He states: "The results are dramatic, and in considering them, it should be borne in mind that most of the cases were chronic out-patients who had been attending at one hospital or another for many years."

This method could be used in the class of patients he describes, and it is probable that only one or two treatments need be used. Lyons,⁵ who first used radium in nasal polyps, screens the tubes so that only gamma and the hard beta rays are used. Referring to his technic, he observes: "Early a dose of fifty milligram hours was used. This has been increased and for the past seven years 400 milligram hours has been introduced forty-eight hours after operation and repeated on the eighth and fifteenth postoperative days."

Scal⁶ applies a 50 mg. capsule of radium element, screened by 1 mm. of platinum in the form of a container which in turn is screened by gutta-percha. This is placed against the spot from which the polyps have been removed. The radium is allowed to remain in place from two and one-half to three hours. The treatment is then repeated in one week. If two such capsules were used, one on each side, the dosage would be three hundred milligram hours at each sitting. For the entire course this would be doubled.

Brooks⁷ uses five 10 mg. needles of radium, each enclosed in a brass container of sufficient thickness to give practically complete screening of the primary beta rays. He says that only the gamma rays are used in this type of work and that the average dosage is 400 mg. hours. As much as 150 mg.

hours may be given at intervals of one week. This would indicate that from two to five treatments is sufficient.

In analyzing the various ways in which radium is used, we find that the needles are used with and without further screening. When screening is used, the dosage time is proportionately increased. Brown uses the needles bare and pushed into place. I wrap them in a thin layer of dental rubber. Scal, Brooks, and Lyon screen the radium in platinum or brass and eliminate most of the beta rays. This method is also used by McCulloch and Robinson.⁸ In trying to evaluate the various methods in use, there is very little difference in dosage when variation in screening is taken into account. All these operators have had good results. The fact that radium is selective in its action on pathologic tissue accounts for these results. The penetration of the beta or gamma rays or both in sufficient dosage, will destroy tissue. The end in view is to destroy the unhealthy and leave the normal structures as little changed as possible. Radium will specifically do that if rightly applied. Nearly all observers have also remarked on the unusual tolerance of nasal tissues to radium. This may be due to the moist character of the parts involved.

In deciding what dosage to use then, there are several remaining factors. One is the patient himself, who may or may not need large total number of milligram hours to clear up his condition. Another factor is a saving of time plus the fact that the size of the object inserted into the nose may be decreased, when less screening is used. And lastly, I⁹ believe that when the treatments are given over a period of months, the patient can be more closely watched to detect any tendency to recurrence. In other words, the treatment is made more flexible, for we are dealing with conditions no two of which are just alike. Patients with polyps should be under observation for several years to be sure they are fully cured. I believe that two years from cessation of treatment with the nose polyp-free would indicate a cure. Another advantage, too, from the standpoint of the patient, is that he can pay for his treatments in installments and thus lighten his financial obligation.

Conclusions

Postoperative uses of radium in nasal polyps possess definite therapeutic advantages. Its action destroys tissue and prevents recurrence of nasal polyps.

In analyzing the various methods in use, our method has several advantages:

1. The treatment time is shortened.
2. Less bulk is placed in the nose.
3. Less screening of the applicator and less exposure time cuts down the effect of gamma rays and increases the action of beta rays, which, we believe, are the ones most effective in these cases.
4. Multiple treatments are of advantage for adapting it to the individual case.

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Discussion of Papers by Drs. J. Coleman Scal* and Walter A. Ford

Dr. H. L. Brooks (Michigan City, Ind.): Everyone in this field must work out a technic best suited for his needs, but the end results of the different workers are needless to say about the same. We have been using radium post-operatively since 1923, in all cases of myxomatous types of nasal polyps and have found that while the polyps sometimes do re-occur, they are of a fibromyxomatous, instead of the myxomatous type. That radium changes the character of the growth is not hard to demonstrate. It is obvious, of course, that its application should be preceded by as complete an operation as is possible. I mean by this that a considerable amount of adjacent tissue not frankly myxomatous also is removed, and where an ethmoid is involved as complete an excision as possible is done. I have been using approximately 50 mg. of radium element in our cases. Our radium is divided into five 10 mg. needles, so that practically any amount necessary up to 50 mg. can be used at a sitting. A brass container 30 mm. long and 5 mm. wide is used. The brass is of sufficient thickness to practically screen the primary beta rays. A rubber cot is fixed over the brass container that screens the secondary rays. The beneficial effects of radium in the nose are due to its well known properties to destroy tissue and produce fibrous formation. It must be borne in mind that radium under such circumstances must be pushed to the point of scar formation. Fortunately the nose tolerates radium exceedingly well. The intensity of the radiation varies, roughly, as the square of the distance, which is probably due to diffusion. The dosage varies in the individual case according to the extent of the process and the reaction of the tissues. Our average dose has been approximately 400 mg. hours.

I concur with everything that Dr. Scal has said. We have found that in the type of tonsils that he has been treating with radium, our results have been much more beneficial with x-rays. This also applies to treatment of tuberculous glands. At our clinic, we have had good results in nasal hemorrhage with radium where other methods have failed us.

Dr. J. Coleman Scal (closing): While Dr. Ford is to be congratulated upon the excellence of his report, I feel that the benefit after polyp operation with radium is due to the gamma rays. The

beta rays are destructive and the gamma are therapeutic. We do not want a destructive action, but rather a constructive effect of the gamma rays upon the cell nuclei. I also found that the dosage after polypolation should not be more than 250 or 300 milligram hours under proper screening. Otherwise one may stimulate dry scab formation and a loss of sense of smell.

Dr. H. F. Plaut (Cincinnati): The use of beta and gamma rays and the screening in polyps is rather a question of space. As Dr. Scal pointed out the beta rays have a more destructive effect not because they are so much different from the gamma rays, but because they are absorbed so much more in the adjacent tissue. If a certain patient has a very restricted and well defined area from which the polypoid degeneration occurs, I think it would be quite proper to use little screening, because as Dr. Ford pointed out, the lesser the screenage the shorter the time of application.

Dr. Raphael Schillinger (Brooklyn, N. Y.): Polyps are not always, or are seldom, limited to the nasal passages. The number of cases that evidence polypoid degeneration of turbinate tissue as compared with the number that have free polyps in the nasal cavities is small. I should say a large number of cases are ones in which polyps extrude from within the sinus. Whether they are the result of a degenerative process following chronic infection with impairment of nutrition to the membrane, or the result of chronic and prolonged irritation by an allergic factor is something that should be determined, in order that the cases may be subclassified and therapy be guided accordingly. Polyps grow like weeds in the garden, and it is important that one determine the extent of such growth within the sinuses themselves in order that one may properly evaluate these.

In the ethmoid the presence of polyps will not be evidenced particularly by clouding or loss of aeration so much as by a loss of trabeculation on the roentgenogram. The loss of cell outlines in the ethmoidal labyrinth is very strong evidence of a degenerative process. On the other hand, a massive shadow in the antrum is also very suggestive of extensive polypolation. It is not uncommon to find a very clean resection of intranasal polyps and then a week or two later a number of polyps present in the nose again, and it is not uncommon to

* Paper appeared in June, 1938, issue of ARCHIVES.

AFTER-CARE OF INFANTILE PARALYSIS:

Braces and Operations *

FRANCIS CARR, M.D.

NEW YORK

I have limited my discussion to braces and operations in the after-care of infantile paralysis. During the last ten years the after-care of poliomyelitis has been thought of mostly in terms of muscle re-education. However, the orthopedic surgeon still is confronted with patients who have not been cured by exercises and supporting measures and operations are still as important as ever. There is a layman's idea that applying a brace to a paralyzed patient is admitting defeat or at least grave doubts as to recovery. Nothing is more erroneous. Any scientific approach to the after-care of paralysis of lower neuron type must be dealt with the problem of "Rest vs. Activity." During the last ten years we have been exposed to the overenthusiastic demand for exercises in paralysis; such enthusiasm being fostered by various groups of laymen, from the President to the Elks, Moose and other benevolent societies. The poliomyelitis patients were exercised in and out of water at an expenditure of millions of dollars and often without the proper control.

I believe that the problem of the after-care of poliomyelitis is an orthopedic problem and should be supervised by the orthopedic surgeon, with the help of the pediatrician, neurologist, physical therapist and other specialists. The long immobilization suggested by Lovett after the 1916 epidemic was followed by an over emphasis on mobilization from 1926 to 1936, and two years ago Kendall in Baltimore shocked the benevolent societies by his logical demonstration of rest with support.

In the Departments of Health of New York State and in my poliomyelitis clinic at the Hospital for the Ruptured and Crippled in New York City, I have attempted to strike a conservative medium, taking advantage of the benefit derived from rest and exercises (in over one thousand cases).

Braces and Supports

In spite of some advancement in our knowledge of poliomyelitis, it is rare that a case is diagnosed before paralysis has set in, except during an epidemic. As soon as muscular weakness has been noted, it is important to splint these muscles in such a position as to prevent over-stretching of the affected muscles and contracture in the opponents. This is best done with circular plaster-of-paris bandages.

After the epidemic in New York City in 1931, we started patients on early exercise for short periods in the fourth week after the acute onset. The patients had muscle re-education exercises daily for about fifteen minutes and were then returned to their plaster shells. We believe that no harm was done and that some atrophy was prevented by this early treatment.

As soon as the muscles have improved 50 per cent, or where no improvement has been obtained, the question arises of getting the patient out

* Read at the Joint Meeting of the Seventeenth Annual Session of the American Congress of Physical Therapy, and the Twenty-second Annual Meeting of the American Occupational Therapy Association, Chicago, September 14, 1938.

of bed. No set rule can be laid down, but I may say that in general the patients are allowed up too soon.

So far as the various affected regions are concerned the following data are based on our actual experience. These are most often neglected and the ensuing slight imbalance of muscle will produce scoliosis. Treatment:

A. Trunk and Head:

1. Plaster-of-paris jackets.
2. Knight spinal brace, Hoke, Goldthwaite, and others.
3. Corsets.
4. Head rests to support the neck muscles.

B. Upper Extremities require:

1. Aeroplane splints.
2. Splinting of the forearm to prevent supination or pronation contractures.
3. Molded splints of Kendalls for the hand and fingers.

C. Lower Extremities require:

1. Brace for back and both lower extremities.
2. Walking caliper brace.
3. Gluteal rest attached to long leg brace for gluteus maximus paralysis.
4. Brace for quadriceps paralysis.
5. Brace for ham string paralysis.
6. Brace for calcaneus with $\left\{ \begin{array}{l} \text{valgus} \\ \text{varus} \end{array} \right\}$
7. Brace for equinus with $\left\{ \begin{array}{l} \text{valgus} \\ \text{varus} \end{array} \right\}$

While these braces are worn physical therapy treatments are considered. Under water exercises are important, first for therapeutic purpose and later for their recreational value. (This is what the President of the United States is doing now.)

Operations

When, in spite of proper physical therapy and support, patients show no more improvement, the question of making him independent of braces must be faced. A number of operations have been tried out. Although we must admit that many have been performed simply because it was possible to perform them, we have some specific ones that I have used on several hundred patients with good results. All operations fall into two classes. First, operations on the skeleton for stability and weight bearing; secondly, operation in the muscles and tendons for balance and activity. The operative procedures embrace:

A. Trunk.

1. Spine fusion.
2. Myotomy.
3. Lowman's on abdominal muscle.

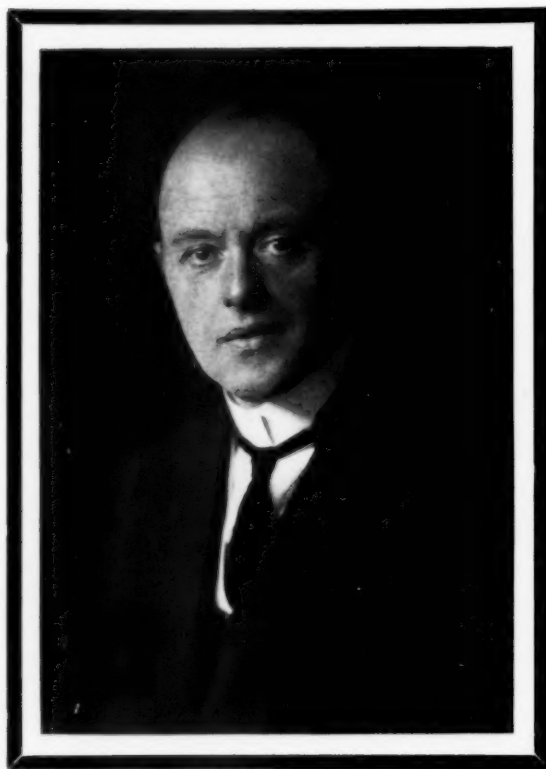
B. Upper Extremities and Shoulder.

1. Shoulder fusion, elbow and wrist fusion.
2. Myotomy and tenotomy of forearm.
3. Cleary's operation for pronation contraction of the forearm.
4. Other muscle transplants.

C. Lower Extremity and Hip.

1. Hip fusion, shelf operation.
2. Knee fusion.
3. Subastragalar arthrodesis, astragalectomy, and the like.

(Concluded on page 242)



ELKIN PERCY CUMBERBATCH — 1880-1939

In the death of Elkin Percy Cumberbatch on March 24 the profession of physical therapy sustained the loss of one of its most eminent members. In the space of a short life span of 58 years Dr. Cumberbatch attained international recognition as the foremost conservative and pragmatic thinker and contributor in the field of electrotherapy. His contributions were always weighty and thought provoking. Outstanding among his works are his large monograph *Medical and Surgical Diathermy; Treatment of Gonococcal Infection by Diathermy; Essentials of Medical Electricity; Lectures on Medical Electrology*, and various papers on electrotherapeutics published in medical journals and textbooks. Dr. Cumberbatch was educated in St. Paul's School, Oxford University and St. Bartholomew's Hospital. He entered Keble College, Oxford with an open scholarship in science. In 1903, he received the degree of Bachelor of Arts after attaining first class honors in the School of Natural Science; in 1904, he was awarded the Welsh-Memorial Prize at Oxford, when he then entered St. Bart's Hospital with a senior university scholarship. In 1909, he graduated in medicine with a B.M., B.Ch. (Oxon) and M.A. degrees. From 1910-11 he was House Physician to St. Bart's Hospital, then became a Member and Fellow of the Royal College of Physicians in 1911 and 1933 respectively. His medical knowledge was broadened by his service as demonstrator in Physiology at the St. Bart's Medical School, Chief Assistant to the Department of X-Ray in this hospital, and Fellow of the Royal Society of Medicine. He attained the honor of being President of the Section of Electrotherapeutics (1921-22), President of the Section of Electrology, Bilingual Congress, London (1922), received the D.M.R.E. degree from Cambridge for nearly 12 years. At his death he held the position of Director of the Electrotherapeutic Department of St. Bartholomew's Hospital and Consultant to the Miller Hospital of Greenwich. Dr. Cumberbatch made an excellent record of war service as one of the outstanding physical therapists at the First General War Hospital in London.

The officers and members of the American Congress of Physical Therapy and the Editorial staff of the ARCHIVES extend their sympathy to the bereaved family of their honored colleague.

ARCHIVES of PHYSICAL THERAPY

OFFICIAL PUBLICATION AMERICAN CONGRESS OF PHYSICAL THERAPY

.. EDITORIALS ..

FOOT TROUBLES — A NEGLECTED FIELD

The foot has from time immemorial been subjected to trauma caused by mechanical stresses and strains incident to locomotion and as a consequence, developed certain functional and organic abnormalities which now form the most exploited and abused field of borderline practice. Today the ailing foot looms as a health problem only second to arthritis, because in America alone over 50 million people are annually squandering a fortune on shoes, arch supports and bizarre treatments for surcease of pain, discomfort and imaginary invalidism. This situation is not only of domestic concern but has actually assumed an international aspect owing to the fact that most governments are vitally interested in the most efficient locomotion of their man power. Accordingly, the collective distress of 40 per cent of our population and the increasing governmental interest in the highest efficiency of the foot have made the public more sensitive to its importance, and the profession more conscious that the problem calls for serious, active and intelligent control by organized medicine.

Unfortunately, the circumstances which have dominated the situation have been influenced by factors partly of our own creation. Our past indifference to the control of this problem has gradually permitted outside interests to dislocate authority and supervision of those so afflicted. Today the general practitioner is in competition with the shoe and arch-support industry, chiropodist and podiatrist, manipulators and venal counter prescribers, most of whom are as hazy about the anatomy and physiology of the ailing foot as is possible by an education that stresses the virtues of profitable barter. It matters little what the distressed individual may suffer from when he seeks relief from the above mentioned sources, because the pain is scrambled into a single etiologic background—the fallen arch. It goes without saying that such a situation has created a widespread evil and provides cause for resentment against those who have tacitly encouraged outside sources to assume responsibility over such an important problem as the foot, especially when it is realized that physical therapy here provides the greatest good for the greatest number.

Today this universal ailment appears to have become the intercompetitive interest of the seventh wealthiest industry in our country—the shoe industry—which finds this venture so profitable that its publicity program for “corrective” and “health shoes” and foot devices run into an annual cost of hundreds of millions of dollars. The types of these shoes are legion, their names provocative, and their cost often as prohibitive as their ugliness. To exploit these shoes under trade names that imply corrective and health promoting qualities to those who in the parlance of the trade are called the “limping legion,” more concern is given to catch phrases that attract the imagination than to conscientious scientific attempts to justify the claims of the industry. According to Morton,^{1,2} shoemen have never attempted an intimate study of the foot and in general have little knowledge of the disorders they profess to correct. At best they have merely adopted certain suggestions from the medical profession and applied these in mass production—a sort of catch-as-catch-can shoe therapy that originated in the clever copy of the paid advertising agent.

Those familiar with the present methods of indiscriminately prescribing or providing so called arch supports on the erroneous assumption that the majority of abnormal conditions of the feet are ascribable to what is vulgarly referred

to as fallen arches, realize the utter fallacy of such aid and advice. Without a thorough grounding in both the anatomy and physiology entering into the mechanism of locomotion, and without a thorough investigation by modern diagnostic measures with the aim of either establishing actual anatomic deviations or recognizing their absence, any attempt at remedying certain vague symptoms by the haphazard application of a "pedal crutch" is at the best a blind sale and purchase. This is all the more reprehensible since every trained physician has it in his power to make use of precise diagnostic measures which will at once suggest to him the proper therapeutic procedure in each individual case. Such service is in compliance with ethical individualistic practice and wholly alien to the present vogue of wholesale dispensing of any and all kinds of miscalled arch supports. This of course, is not to be construed as condemning proper supports or proper shoes sold by ethical dealers provided they are placed where indicated by an actual depression of the ligamento-muscular system evidenced by radiograms and other diagnostic measures familiar to the physician.

Whatever the causes and whoever is to blame, present day practitioners of ethical medicine are confronted by the fact that they are facing unfair competition so far as the handling of clientele is concerned through the back doors which have been left open for the swarming in of all sorts of half-baked cultists, who unhampered by ethical regulations proclaim themselves as possessors of special qualifications beyond the ken and reach of scientific medicine. This situation, too well known to need more than mention, holds good also with reference to the management of foot affections not requiring major surgical intervention. Here we confront a class of men who with the most superficial training but under the protection of a self-styled professional status arrogate to themselves this therapeutic field, for which they are no better qualified than the manicurist is for the scientific management of crippled fingers and hands. By what stretch of imagination self-styled podiatrists consider themselves as representing a sub-specialty of medicine or surgery is to say the least highly problematic. The fact remains that chiropodists are at present simply a necessary adjunct as pedicures and should not be permitted to exceed their proper boundaries and assume tasks within the province of scientific medicine.

The medical profession itself is greatly to be blamed for this dilemma as is evidenced by the history of medical progress of the past four decades. In whatever field the profession has permitted the exploitation of certain phases of medicine to fall into the hands of laymen with fantastic ideas and visions, popular interest was aroused but directed into improper channels. A similar situation applies to a number of distressing ailments of the feet which have been handled by physicians in general in a rather stepmotherly fashion. The penalty for this ultra-conservatism on the part of the medical profession is felt today through the vogue of the public to seek aid and advice from shoe clerks and similarly qualified individuals.

From what has been said it should be clear that physical therapy in the past has neglected a rich field for doing a vast amount of good. There is no question that for the ailments under consideration physical procedures are not only definitely indicated but contain the element most positive for therapeutic effectiveness. Possessed as we are of facilities beyond the mere application of shoe inlays, the public soon will appreciate that real aid can be had only from therapeutic measures within the frame of our specialty. An educational program to that effect will in the near future bring about a restoration of the proper equilibrium for the good of both concerned, patients and our profession.

Reference

1. Morton, D. J.: *Oh, Doctor! My Feet*. New York: D. Appleton-Century Company, 1939.
2. —————: *The Human Foot*. New York: Columbia University Press, 1935.

NEW YORK WORLD'S FAIR AND THE EIGHTEENTH ANNUAL SESSION

Plan now to spend your vacation period in New York. Plan your vacation for September 5, 6, 7, and 8, so that you can attend the 18th annual session of the Congress and visit New York World's Fair.

The program has been arranged in short daily sessions, allowing ample time to visit the fair grounds and see the most unusual exhibits of all time. If you do not drive, take advantage of the reduced round trip rates on the bus or railroad.

A program which will be in keeping with New York's gala event will be offered the medical profession. With physical therapy making pace-setting strides, all that is new and worth-while in the field will be presented by outstanding authorities. The scientific and technical exhibits should prove most interesting and instructive. All the sessions of the Congress and also the exhibits which are a part of the convention will be held on the Ball Room floor of the Hotel Pennsylvania. The hotel has been designated as the official convention headquarters.

Preceding the convention session, on August 30 and 31, September 1 and 2, an intensive seminar in physical therapy will be conducted under the auspices of the Congress. The mornings will be devoted to specially arranged hospital clinics, the afternoons to didactic lectures, and the late afternoons to small group conferences. Every effort has been made in arranging the instruction schedule to make this course extremely valuable to physician and technician. Registration is limited to 100. Because of this, early registration is solicited. Do not send remittance for registration, without first requesting an application blank as registration is by application only. However, application properly filled out must be accompanied by the fee, which is \$25 for technicians and non-members of the Congress. Members of the Congress will be charged \$20.

It is emphasized that because of the World's Fair all hotel facilities will be at a premium. The Congress has a commitment for a specified number of rooms, but in order to take advantage of this, reservations must be made NOW. Do not delay as you may be disappointed if you do not make a reservation promptly. This may be made directly with the hotel management or through the central office of the Congress.

For further information concerning the 18th annual meeting, address the Executive Secretary, American Congress of Physical Therapy, 30 North Michigan Avenue, Chicago.

Correspondence

An Error Acknowledged

To the Editor: The reviewer of Physical Therapy: Theoretical and Clinical writes: "... contains much that is uncritical, unauthentic and unauthoritative. Among the facts that are unauthentic, it is noted that credit is frequently given where credit is not due; for instance (page 49), the author attributes to the late Dr. Grover an illustration of a classic word picture on electrolytic solution that originated with Sir Lewis Jones and was quoted by the late Dr. Massey in his own text."

Disregarding the fact that a fact is defined as "any statement strictly true," and therefore cannot be unauthentic, I wish to state that I am fully aware of the reference to Sir Lewis Jones on page 36 of *Massey's Practical Electrotherapeutics* and 36 of *Massey's Practical Electrotherapeutics and Diathermy*, 1924, to the ballroom analogy to an electrolytic solution. I must, however, still acknowledge my ignorance of any analogy of Sir Lewis Jones, or anyone else, that would apply to Dr. Grover's word illustration of voltage, amperage, and ohmage as described so graphically in the latter's *Handbook of Electrotherapy*, 1922.

I do not know what your reviewer's concept of "unauthentic" may be, because I simply quote Grover's own words and, as he used no quotation marks himself, I sincerely trust for the reputation for authenticity of a loved and revered teacher and a past-president of the Congress of Physical Therapy, that

no reviewer is now going to accuse him, directly or indirectly, of plagiarism when unable to defend himself.

For the benefit of myself, your readers, and posterity, I should greatly appreciate the exact and authentic source of your reviewer's "illustration" in question.

Enquiringly yours,
JOSEPH E. G. WADDINGTON.

Comment

The above communication was submitted to the reviewer for reply. He advises that he has inadvertently confused the above mentioned quotation owing to the similarity of the illustrations and therefore concedes that Dr. Waddington has a just ground for complaint and to whom an apology is due and gladly rendered. Incidentally the statement in the communication that the late Dr. Grover was at one time President of the Congress is to our regret not in accordance with the facts, since this organization was deprived of having its destinies directed by this distinguished American pioneer. The Editor desires to take advantage of this opportunity to express the policy of the *ARCHIVES* in being constructive, and helpful in criticism of books submitted for review and to limit destructive criticism to unavoidable necessity. For this reason we are particularly pleased to express our regrets for the error in this review.

THE EDITOR.

After Care of Infantile Paralysis — Carr

(Continued from page 237)

4. Myotomy, tenotomy for contractures about hip, knee, ankle and foot.
5. Muscle and tendon transplants about hip, knee, ankle and toes.

This being only a brief outline of a very wide subject, it should be emphasized that, hand in hand with the application of braces goes muscle re-education, and those treatments are especially necessary after many of the operations, such as the muscle transplants. I am a great believer in occupational therapy as well as physical therapy. I am afraid that occupational therapy needs more emphasis in the after-care of disease and especially of infantile paralysis. To me, occupational therapy is a purposeful movement and should go hand in hand with physical therapy. Physical therapy is responsible for a very important chapter in the after-care of infantile paralysis. I am looking for more co-operation from occupational therapy.

SCIENCE, NEWS, COMMENTS

Committee On American Health Resorts

Pursuant to resolutions adopted by the House of Delegates of the American Medical Association at the San Francisco Session, the Board of Trustees has appointed the following Committee on American Health Resorts:

Dr. Bernard Fantus, Chairman, Chicago.

Dr. Walter S. McClellan, Saratoga Springs, N. Y.

Dr. Euclid M. Smith, Hot Springs National Park, Ark.

Dr. M. B. Jarman, Hot Springs, Va.

Dr. William P. Holbrook, Tucson, Ariz.

This committee is now engaged in outlining its plans of work and will no doubt submit a report to the Board of Trustees which can be transmitted to the House of Delegates at its next meeting. — [J. A. M. A. 112:1376 (April 8) 1939.]

Medical Society New York State Physical Therapy Session

Wednesday, April 26, 1939, 10:00 A.M.
The Onondage, Syracuse, N. Y.

Chairman's Address — "Physical Therapy as a Useful Adjuvant in Problems of Rehabilitation of the Arthritic." *Madge C. L. McGuinness, M.D., New York.*

1. "Chronic Arthritis. Differential Diagnosis: Special Treatment Methods: (Medical, Orthopedic, Physical Therapy)." Kodachrome. *Bernard L. Wyatt, M.D.; Robert A. Hicks, M.D., and Harry E. Thompson, M.D., The Wyatt Clinic, Tucson, Arizona.*

2. "The Role of Posture in Chronic Arthritis." Lantern Slides *Henry Jordan, M.D., New York.*

3. "Prophylactic Exercises for Children." Lantern Slides. *Jerome Weiss, M.D., New York, and Hans J. Behrend, M.D., New York.*

Discussion: *Harold J. Harris, M.D., Westport, N. Y.; Madge C. L. McGuinness, M.D., New York, and Samuel Kleinberg, M.D., New York.*

4. "Have Spas an Essential Place in the National Economy and How Responsible Is Organized Medicine in Efforts to Promote and Control Their Activities?" *John Carroll, M.D., New York.*

Discussion: *Walter S. McClellan, M.D., Saratoga, N. Y.*

American Association On Mental Defect

The 63rd annual convention of the American Association on Mental Defect will be held at the Palmer House in Chicago, Illinois, from May 3rd to 6th, inclusive.

Dr. Antoine Bécère — 1857-1939

The dean of French radiologists, Dr. Antoine Bécère, died February 25 in Paris at the age of 82. About a year after the discovery of the x-rays Bécère was present during a radioscopic examination for suspected pulmonary tuberculosis. He immediately foresaw the future of this new method of diagnosis and began to devote his energies to its clinical application, being one of the first to recommend the use of a dark room and a fluoroscope in the examination of lesions of the chest. He soon extended the roentgen method to the diagnosis of pathologic changes in other viscera and then began to study the effects of roentgen therapy on neoplasms. He was elected a member of the Academy of Medicine of Paris as a recognition of his contributions to the development of roentgenology. During the World War Dr. Bécère was in charge of a school in which radiologists were trained for service in army hospitals. After the war and until a few weeks before his death, he took a vigorous part in the activities of the various medical societies in France and foreign countries. He suggested the use of iodized oil as an opaque medium in the diagnosis of uterine and tubal lesions. During the past twenty years he had become interested in the relation of ovarian and testicular tumors to the hypophysial hormones and in many other research problems. In 1936 many of his former pupils met to celebrate the eightieth birthday of this untiring worker, who until a few days before his death was busy editing a paper on experimental studies at the Radium Institute of Paris. In addition to serving a term as president of the Academy of Medicine, the leading society here, Dr. Bécère was an honorary member of many French and foreign medical organizations. — (Foreign Letters, J. A. M. A. April 15, 1939.)

Meeting American Physiotherapy Association

The 18th Annual Convention of the American Physiotherapy Association is to be held at Hotel Cosmopolitan, Denver, Colorado, June 25th-30th of this year.

Officers and members of the American Registry of Physical Therapy Technicians are cordially invited to attend.

Pacific Physical Therapy Association

The regular monthly meeting of the Pacific Physical Therapy Association was held at the Los Angeles County Medical Building, on Wednesday, March 29, 1939. The following program was presented:

1. Importance of the Heat Labile Factor in Diet, *Frank M. Pottenger, Jr., M.D., Monrovia;* 2. Aids in Muscle Training — a motion picture.

New York Physical Therapy Society Meeting

A meeting of the New York Physical Therapy Society was held on Wednesday, April 5. The Physical Therapy Department of Montefiore Hospital, New York, presented the following program:

Scientific Session: 1. Demonstration of Capillary Microphotographs in Peripheral Vascular Disease. 2. Presentation of Patients Illustrating Papers of the Evening.

Papers of the Evening: 1. The Diagnosis and Treatment of Shoulder Pain — J. Byer, M.D. 2. The Problems of Juvenile Chronic Polyarthritides — I. D. Stein, M.D. 3. Valuable but Little Used Physical Measures in the Treatment of Peripheral Vascular Disease — K. Harpuder, M.D.

Discover Substitute for Blood Transfusion

A substitute for blood for transfusion to revive patients suffering from shock has been discovered by Drs. H. A. Davis and J. F. Blalock, Jr., of the University of Tennessee. Instead of blood, they have found, physicians can use the fluid removed from patients suffering from abdominal dropsy or from pleurisy.

This fluid, called ascitic fluid, must be typed just as blood must be before use in transfusions. It is useful in cases of shock in which there is a concentration of red blood cells but a deficiency of the fluid portion of the blood. Storing the fluid in a refrigerator does not affect its usefulness. Technical details of their investigations of this substance as a substitute for blood when the latter is not available have been reported to the *Journal of Clinical Investigation*. — *Science News Letter*.

New Infant Disease Cause Is Discovered

The cause of a new and fatal convulsive ailment of babies has been identified by Drs. Abner Wolf, David Cowen and Beryl Paige of the College of Physicians and Surgeons, Columbia University.

Like the so-called "sleeping sickness," the new disease attacks the brain, but it also attacks other tissues such as the spinal cord and is called encephalomyelitis. It is due, the Columbia investigators find, to a large one-celled parasitic animal form known as a toxoplasma. This kind of germ has been found in animals but has not previously been recognized as a cause of human illness.

Other forms of human disease due to this kind of germ, however, very probably exist, the scientists point out.

Proof of the fact that the toxoplasma was the cause of the fatal illness of one infant was obtained when material from the brain and spinal cord of the infant was injected into laboratory animals and caused the same illness in some of them.

Toxoplasma hominis is suggested as a name for the germ that caused the human ailment. Besides the case studied by the Columbia scientists, four others, believed due to the same germ, have been reported, one each from New York City, Chicago, Prague and Rio de Janeiro. — *Science News Letter*.

Meetings of Physical Therapy Organizations

In this permanent column will be published information about meetings, election of officers, etc., of physical therapy organizations. New data should be sent promptly to the office of the Secretary, 2 E. 88th St., New York.

American Congress of Physical Therapy: 18th Annual Session, Hotel Pennsylvania, New York; September 5, 6, 7, 8, 1939; Dr. Richard Kovács, 2 East 88th Street, New York, Secretary.

Special Instruction Seminar, August 30, 31, September 1, 2, 1939, preceding 18th Annual Session, American Congress of Physical Therapy, Hotel Pennsylvania, New York. For detailed information see announcement elsewhere in this issue.

Eastern Section, American Congress of Physical Therapy, under auspices of New York Physical Therapy Society, and the Pennsylvania Physical Therapy Association, Saturday, April 22, 1939, Jefferson Medical College, Philadelphia; Walter J. Zeiter, M.D., Secretary, Cleveland Clinic, Cleveland, Ohio. (See announcement elsewhere, this issue.)

American Physiotherapy Association: 18th Annual Convention, Hotel Cosmopolitan, Denver, Colorado, June 25, 26, 27, 28, 29, 30, 1939; Mrs. Eloise T. Landis, 2065 Adelbert Rd., Cleveland, O., Secretary.

Medical Society of the State of New York Session on Physical Therapy: The Onondage, Syracuse, N. Y., Wednesday, April 26, 1939, 10:00 A.M. Dr. Harold J. Harris, Westport, N. Y., Secretary. (For detailed program see elsewhere, this issue.)

Pennsylvania Physical Therapy Association: meetings at the Philadelphia County Medical Society Building, third Thursdays from September to June; Dr. Arno L. Zack, 216 East Broad Street, Bethlehem, Pa., Secretary.

New England Physical Therapy Society: meetings at Hotel Kenmore, Boston on third Wednesdays from October to June; Dr. William McFee, 41 Bay State Road, Boston, Mass., Secretary.

Pacific Physical Therapy Association: meetings at Los Angeles County Medical Association Building, fourth Wednesday. Clarence W. Dail, M.D., Sec'y., Treas., Loma Linda, Calif.

New York Physical Therapy Society: meetings on first Wednesday from October to May; Dr. (Continued on page 248)

THE STUDENT'S LIBRARY

OH, DOCTOR! MY FEET. By *Dudley J. Morton, M.D.*, Associate Professor of Anatomy, College of Physicians and Surgeons, Columbia University. Cloth. Pp. 104 with illustrations. Price, \$1.50. New York and London: D. Appleton-Century Company, Inc., 1939.

This small volume conveys one of the most important messages to the profession by pointing out how we have neglected the patient with foot trouble, and thus traded a golden opportunity for less than the figurative pot of porridge. Dr. Morton, an authority on anatomy and especially of the foot, presents in informal discussion a cross-section of the adventures of a fictitious Dr. Nelson who is especially interested and well informed on the signs and symptoms of the much neglected foot. The oft heard, "Oh, doctor, my feet!" becomes the accusing voice of our conscience when we read that this complaint involves at least 40 per cent of our population and that approximately fifty million people in the United States alone, are daily suffering because of the inertia of a self-satisfied misinformed profession. The reader becomes shocked not only because of the follies here committed in the name of ignorance, but is astonished at the extraordinary exploitation, cost and crippling that has followed in the wake of this medically neglected problem. Here is the most challenging, informal and eloquent exposition on the subject. The facts and contents are so provocative that it will stir and hold one's interest to the very last page of this small book. It points out in the course of 15 short chapters the simplicity of treatment and the fallacy of traditional teaching. It explodes the theory of the transverse metatarsal arch, the value of so-called arch supports and the much exploited and costly shoes. In an indirect manner the book is a splendid sermon how the profession and especially those informed in physical procedures can better and legitimately serve the public by reviving its own interest in this problem and managing it according to the scientific teachings of Dr. Morton. In the vast majority of instances the antero-posterior roentgenogram will point out the actual condition of the patient, and the indication for rest, heat or contrast baths and the use of inner soles that compensate abnormal and harmful strains over the wrong weight bearing metatarsals. "When persons with foot trouble begin to consult their own physicians about it, they will receive the best and least expensive help—and the foot problem will be on its way toward solution," advises the author. If the profession will but heed the plain and simple truths here presented, the greater part of the 40 per cent of our population will be rescued from a formidable racket which is today exploited by quasi professions and concerns whose interest is in the turnover of the dollar at the expense of the patient's dolor. This book is enthusiastically endorsed and highly recommended to the profession.

BEHANDLUNG RHEUMATISCHER ERKRANKUNGEN MIT ULTRA-KURZWELLEN. By Professor Dr. *Erwin Schliephake*, Leitendem Arzt der Balserischen Stiftung Giessen. Paper. Pp. 104 with 27 illustrations. Price, RM 5.25 (Der Rheumatismus, Collection of Special Contributions on the Study of Rheumatic Diseases. Edited by Professor Dr. *Rudolf Jürgens* of Berlin, Volume 8.) Dresden and Leipzig: Theodor Steinkopff, 1938.

That the profession has become more rheumatism conscious is indicated by the increasing literature on this protean problem. The above listed brochure is the eighth of an extensive group of contributions on the study of every possible phase of the rheumatic problem, published under the editorship of Professor Dr. *Rudolph Jürgens* of Berlin. As a collaborator in this undertaking, *Schliephake* herein reviews in the space of 100 pages, divided into three comprehensive chapters and an index, the adjuvant nature and the therapeutic effect of short waves on an extensive group of symptoms related to rheumatic disease. It is to the credit of the author that the exposition reviews the successes, weakness, and failures, the limitations and technical handicaps encountered with the use of short waves in the frankest, critical manner. One warmly agrees with *Schliephake* that there is more to short wave treatment than the book learning of a mere technic, or the assurance that one's technician has become proficient in turning a switch. Despite enthusiasms and optimistic reports, it is pointed out that ultra-short wave therapy is in the midst rather than at the end of its developmental stage, and it thus behooves the profession to deal with this problem in the statistical, objective manner in order to confirm the scattered and promising results reported in the literature. Accordingly, the work as a whole is not only thought provoking, but also introduces a critical approach as a frame to the most concise and authoritative discussions on the value and limitation of ultrashort wave diathermy in rheumatic affections. Briefly, the work contains a foreword by Professor *Jürgens* that tersely reviews the importance of the problem and the role played by physical measures, and includes an appreciation of the status of short wave therapy in rheumatic disease. Chapter 1 surveys the etiologic factors, such as infections, weather, climate, and the like. Chapter 2 considers the technical nature and heat production of apparatus developed and used by the author in his clinic, and also discusses methods best to exploit these instruments. Therapy is expatiated in greatest detail, but is here mainly limited to the peripheral affections of the body. The large space devoted to this section is naturally proportionate to its importance because the exposition includes an analysis of technics, dosage and case histories, all of which are detailed to a satisfactory degree. One closes this brochure with an impression that the text has gained in lucidity by the author's ob-

servance of brevity, that the exposition was kept within the bounds of proven experience, and that the value of short waves was emphasized on the basis of a conservative estimation of facts.

THE SCIENCE AND ART OF JOINT MANIPULATION. By *James Mennell, M.A., M.D., B.C. (Contab.)* Consulting Physiotherapist, St. Thomas' Hospital, and Lecturer Massage Training School. Vol. 1—**THE EXTREMITIES.** Cloth. Pp. 233 with 284 illustrations. Price \$4.50. Philadelphia: P. Blakiston's Son & Co., Inc. 1939.

Under the name of manipulation, technics are now utilized that range from haphazard application of brute force to manual efforts involving a dexterity that comes from special training along anatomico-clinical lines. Today the very mention of manipulative therapy creates a picture of abusive treatment exploited by cultists. Bone setters have for long practiced their mystical art under a cover of divine assistance, and the osteopath and the chiropractor though some twenty years apart in birth, discovered in the defenseless spine and sacroiliac the cause of most of the human diseases and preached manipulation as the sovereign remedy. This fallacy and the reported injuries consequent to trauma induced by ignorance have raised a wall of distrust that as Mennell points out has overclouded the "enormous mass of testimony that manipulative treatment has a real potentiality for good in a great variety of cases." Accordingly this volume is a timely contribution, for it reflects the rich experience of a conservative and critical student whose opinions have long been accepted as authoritative in a related field. The work makes no pretense at exhausting the subject, but rather provides a clear analysis of its possibilities and limitations. It presents "hard and fast rules from an educational standpoint as the rock foundation on which to build" and through which Mennell hopes, fellow practitioners may find guidance necessary to render treatment by manipulation a standard one. Both because of the controversial nature of the subject and the suspicion of the medical profession, the author first reviews its pros and contras, its historical background and offers a scientific explanation of the meaning of a joint lesion, and the relationship of pain to such a lesion. From this it is shown that there is no magic in joint manipulation, and that relief is attained in accordance with the actual laws of anatomy, physiology, pathology and, yes, psychology. Furthermore it is pointed out that such treatment should not be viewed with the prejudice associated with fantastic claims because there is a scientific basis for its use, and hence should have a place in physical medicine. To the uninitiated student, chapters one to four will be of particular value. From these he will obtain a new orientation on the status and function of joint lesions, the meaning of referred pain throughout the body, and special guidance on rules of joint manipulation which took the author thirty years to acquire. Unquestionably this work will come to be regarded as the most practical source of information and one of the most authoritative of contributions on the value of manipulation in chronic ailments. It is predicted that this volume on the science and art of joint manipulation will become

the *zade mecum* of future students for it will reopen to the profession its possibilities as an important adjunct to physical medicine.

THE CHICAGO RECREATION SURVEY. Volume III: Private Recreation. By *Arthur J. Todd*, Chairman, Department of Sociology, Northwestern University, in collaboration with *William E. Byron*, Chairman, Division of Social Work, Northwestern University and *Howard L. Vierow*, Director, Chicago Recreation Survey. Boards. Pp. 167 with 30 maps. Chicago, 1938.

This is the third volume of a recreation survey conducted under the auspices of the Works Progress Administration, the National Youth Administration and the Illinois Emergency Relief Commission. It offers an excellent review of the recreational facilities in Chicago. The whole field is covered in chapters dealing with settlement, community centers and related group agencies; religious agencies, boys' clubs, the Young Men's Christian Association, Young Women's Christian Association, Catholic Youth Organization, Knights of Columbus, B'nai B'rith; National Boys' and Girls' Organizations in Chicago; Nationality Groups; Social Clubs; Athletic Organizations and Industrial and Trade Union Recreations. For the first time these activities in Chicago have been published under one cover. Much of this work has been unsuspected in the minds of all but a few specialists. For example, it is doubtful whether even Chicago church leaders were aware of the large proportion of the recreational contributions made by the 1,577 local churches. This study should be of great interest to social and recreational therapy workers.

THE TREATMENT OF FRACTURES. By *Charles Locke Scudder, A.B., Ph.B., M.D., F.A.C.S.*, Consulting Surgeon to the Massachusetts General Hospital; Formerly Assistant Professor of Surgery at the Harvard Medical School; Fellow American Surgical Association; Member of the American Society of Clinical Surgery. Cloth. Pp. 1208 with 1717 illustrations. Eleventh Edition, Revised. Price \$12.00. Philadelphia and London: W. B. Saunders Company, 1939.

Since 1900 Scudder's book on Fractures has been a world authority on this subject. This latest edition has been completely rewritten, obsolete methods have been deleted, new methods of diagnosis and treatment have been added. There are also hundreds of new illustrations. The treatment of fractures is of especial interest to physicians in charge of hospital physical therapy departments. Scudder emphasizes that massage and mobilization find "application in every fracture of a long bone without any exception." He also states: "Hospital authorities do not yet comprehend the value of this treatment," and "Many of the mediocre results following fracture are because of the lack of appropriately timed and supervised massage and mobilization." There are twenty contributors of chapters on special fracture problems. The presentation is systematically arranged to give the general practitioner as well as the surgeon clear and definite guidance

in the treatment of all forms and types of fracture. The illustrations are excellent. This volume is highly recommended as a complete guide to the modern management of fractures.

TEXTBOOK OF NEURO-ANATOMY AND THE SENSE ORGANS. By *O. Larsell*, Ph.D.,

Professor of Anatomy, University of Oregon Medical School, Portland. Cloth. Pp. 343 with 232 illustrations. Price \$6.00. New York and London: D. Appleton-Century Company, Inc., 1939.

This textbook is from the pen of an experienced teacher and is primarily intended for first year medical students who are receiving instruction in the intricate anatomy of the nervous system. The general presentation stresses function, with emphasis being placed on the nervous system. The author states that considerable use has been made of comparative anatomy because it affords aid to a better understanding of structure and function. At the end of a number of chapters there is given a brief description of some lesions in various parts of the nervous system. These lesions and their effects are stated simply and concisely with the anatomic basis of interpretation kept in the foreground. These sections furnish an excellent introduction to clinical neurology, and aid the student in thinking as early as possible in terms of functional anatomy. Although this book is intended for students all physicians interested in neurology and neurosurgery will find therein anatomic data of value, while to many it will serve as a refresher course.

ORTHOPAEDIE UND KINDERLAEHMUNG.

By *Friedrich Mommsen*. Paper. Pp. 59, with 36 illustrations. Price, 3.80 R.M. Stuttgart: Ferdinand Enke Verlag, 1938.

This is an excellent monograph of fifty-nine pages on the treatment of infantile paralysis. It is written from the physiologic and anatomic point of view. The author takes the position that contractures are not a necessary sequelae of this disease but when they do occur, they should be corrected by the application of apparatus which takes into consideration the anatomy and function of the part involved. The monograph is well illustrated with 36 photographs and line drawings. Anyone interested in the problem of infantile paralysis will find this German book worth reading although it offers nothing basically new to most American workers in this field. A chapter is devoted to each of the following subjects: orthopedics and locomotion apparatus; origin and significance of contractures with infantile paralysis and

its prophylaxis; treatment of contractures; prevention and treatment of foot deformities; the investigation of paralysis as such and in the main the arrangement of indications; the help of orthopedics with the treatment of early infantile paralysis; the significance of orthopedic apparatus for the treatment of infantile paralysis; the final situation of the paralysis and the operative treatment; infantile paralysis and society. The final twenty-six pages of this interesting book are devoted entirely to an excellent series of illustrations. It is to be regretted that this book does not take into consideration the important place that physical therapy does play in the after treatment of this crippling disease.

LANDMARKS IN MEDICINE. LECTURES OF THE NEW YORK ACADEMY OF MEDICINE. Introduction by *James Alexander Miller*, President, New York Academy of Medicine. Cloth, Pp. 347. Price \$2.00. New York and London: D. Appleton-Century Co., 1939.

This small size volume contains a carefully edited series of seven lectures delivered before the laity by prominent specialists under the auspices of the New York Academy of Medicine. This as well as other series of lectures of a similar nature have been held as a means of establishing a better appreciation of the value of scientific medicine on the part of cultured laymen. This end has been fully achieved, for apart from the various interesting subjects treated, each presentation is made in a literary style betraying a high degree of perfection and bordering on what may well be considered a classicism. The very first lecture presented by the distinguished medical historian Francis R. Packard reviews the story of the development of modern surgery from its humble beginnings at the hands of partly tolerated barbers, especially in Great Britain. Another lecture conveys an excellent idea of the import of modern medical research which was delivered by Alfred E. Cohn. Other essays of especial interest deal with medico-legal aspects under the attractive titles "Dr. Watson and Mr. Sherlock Holmes" (Martland); "The Search for Longevity" (Pearl); "Medicine in the Middle Ages" (Walsh); "Medicine and the Progress of Civilization" (Burbank), and "X-Ray within the Memory of Man" (Cole). When it is stated that each lecturer has carefully avoided commonplaces and has treated his subject in keeping with the dignity of both lecturer and audience, then it will be realized that the work can well be placed in the hands of our most discriminating patients. But physicians, too, will greatly enjoy its perusal and undoubtedly obtain data that are not available in the majority of general works on medical history.

(Continued from page 244)

Madge C. L. McGuinness, 1211 Madison Avenue, New York, Secretary.

Kings County Medical Society, Physical Therapy Section; meetings at 1313 Bedford Avenue, Brooklyn, bi-monthly on second Thursdays; Dr. H. T. Zankel, 5 St. Paul's Place, Brooklyn, Secretary.

Fifth Dimension Entered by Professor Einstein Accounts for Electro-Magnetic Effects

Prof. Albert Einstein has entered the *fifth* dimension in his mathematical calculations seeking to link gravitation and electricity into one unified theory which would explain all physical happenings in one broad concept.

In the *Annals of Mathematics* (July, 1938) is a complex paper by Prof. Einstein and Peter G. Bergmann, assistant at the Institute for Advanced Study, entitled "On a Generalization of Kaluza's Theory of Electricity." Prof. Theodor Kaluza of Göttingen University, Germany, reports Prof. Einstein's important paper, introduced the fifth dimension into conceptions relating gravitation and electricity but used this fifth dimension only as a mathematical idea without physical meaning. Prof. Einstein's new approach ascribes a physical reality to this fifth dimension. But with this step the distinguished mathematician finds himself in a kind of space which is truly puzzling.

"There have been many attempts," reports the Einstein paper, "to retain the essential formal results obtained by Kaluza without sacrificing the four dimensional character of the physical space. This shows distinctly how vividly our physical intuition resists the introduction of the fifth dimension. But by considering and comparing all these attempts one must come to the conclusion that all

these endeavors did not improve the situation. It seems impossible to formulate Kaluza's idea in a simple way without introducing the fifth dimension.

"We have, therefore, to take the fifth dimension seriously although we are not encouraged to do so by plain experience," explains Prof. Einstein.

Thus reluctantly, the distinguished mathematician states, he is entering into still more complex mathematical theories.

In his five-dimensional theory, space is closed along a vector indicating the fifth coordinate. This, he says, is the essential difference between his new work and that of Prof. Kaluza.

"By making this change," Prof. Einstein says, "the basic assumptions of the theory are considerably simplified. Furthermore it is much more satisfactory to introduce the fifth dimension not only formally, but to assign to it some physical meaning. Nevertheless there is no contradiction with the empirical four-dimensional character of physical space."

Like his previous theories, the new Einstein five-dimensional world has its own paradoxes. For example a single point P in physical space is represented by an infinity of points in the five-dimensional space.

Ordinary space, as most people envision it, consists of the three dimensions of Euclidean space which we call height, breadth, and thickness, in speaking about an object like a box. To these Prof. Einstein linked time as a fourth dimension in his relativity theories.

The fifth dimension introduced now accounts for properties of the electro-magnetic field which previously have not appeared in relativity. Instead they were accounted for by other theories not linked with gravitation. As would be expected, the new theory is enormously complex. For example, it is necessary to introduce a special coordinate system in which space is described by 14 different functions. — *Science News Letter*.

Radium In Nasal Polyps — Ford

(Continued from page 235)

find a good resection and for a period of more than two years freedom from evidence of polyps, and then a regrowth in the form of a great big group. Under the circumstance I wish to suggest the use of lipiodol in our diagnostic practice. It helps to clear up anatomical characteristics and also functional capabilities of the membrane. Use that as a control, and then after your radium treatment is complete, repeat that diagnostic operation and see what effect you have had on the membrane within the sinus. If

surgery is to be applied prior to the application of radium, let that include good surgery of the sinus and then application of radium. I am sure your results will be most enlightening and will be much more acceptable than they are without this evidence.

Dr. Walter A. Ford (closing): I take issue with Dr. Scal on the destructive action of beta rays as we have used them. I have never seen any crust formation or a drying out of the nose.

INTERNATIONAL ABSTRACTS

Sterilization of Air in Operating Room.

Arch. Surg. 37:1064 (Dec.) 1938.

Hart analyzes the results obtained in a total of 456 clean primary incisions and eighty-six reopened clean incisions out of more than 800 operations performed in a field of bactericidal radiation. The operations had a potential source of infection, and data on them were not used for the statistics. The operations were gastric or intestinal resection, cholecystectomies, appendectomies and amputations of gangrenous extremities. A striking improvement in the postoperative course of these patients has been evident. Unexplained infections in primary incisions have been almost, if not entirely, eliminated. More striking than this reduction in the number of infections has been the reduction in the elevation of temperature following operation and the shortening of the duration of this postoperative elevation. The postoperative course of the patients has been improved. They show less reaction in every way; there is less tenderness in the incision, and the period of convalescence is reduced. The author concludes that postoperative wound infections have been reduced more than 85 per cent. The occasional death from wound infection has been eliminated. The number of patients with postoperative temperature above 100.4 F. has been reduced in thoracoplasties from 68 per cent to 30 per cent, in radical mastectomies from 46 to 34 per cent and in inguinal herniorrhaphies from 36 to 22 per cent. The number of patients with a temperature above 99.5 F. for more than four days after operation has been decreased in thoracoplasties from 78 to 22 per cent, in radical mastectomies from 54 to 21 per cent and in inguinal herniorrhaphies from 46 to 14 per cent.—[Abst. J. A. M. A. 112:84 (Jan. 7) 1939.]

Treatment of Tuberculosis of the Bladder. Lorenzo F. Milliken.

Pennsylvania J. 42:592 (Jan.) 1939.

There is great variety in the methods of local treatment that have been recommended for vesical tuberculosis. This very multiplicity tends to confirm the stubbornness of the malady and the inadequacy of many of the methods. Of these a few have been found of very definite value in the relief of symptoms and the healing of vesical lesions.

Ulcerations of the mucosa are best treated by light fulguration. Even before nephrectomy is done, profound relief can be given the patient by blanching the surface of the ulcers with the Bugbee electrode. Filling the bladder gently with oxygen gas, or even air, gives pronounced relief of symptoms in the milder cases and may be used to advantage after fulguration.

Another method of treatment, not commonly employed and which has been found to give quite a measure of symptomatic relief, is gentle irrigation

of the bladder through a soft rubber catheter with a 1 or 2 per cent solution of sodium perborate.

Symposium: Treatment of Fractures. E. L. Eliason.

Surg., Gynec. & Obstet. Feb. 15, 1939.

Fractures recover best when the nutrition of the bone and those structures associated with it most nearly approach normal. Physical therapy aids in restoration of blood supply. It should begin, if feasible, when the treatment of the fracture begins, not after union has occurred.

Return to full function of weight bearing must be withheld until solid clinical union is found to be present. The roentgenographic evidence with regard to the rigidity of callus cannot be depended upon.

The patient himself is his best physical therapist. It should be explained to him that return to function is his job, and that he can recover only by exercise, supplemented by massage and heat. He should be carefully instructed in the use of all of these measures. Aided active motion should be explained to him. Pain is Nature's warning of trouble. He will not injure himself, while a physical therapist might. If a therapist is on the case at once, the patient places all responsibility on the attendant since the patient does not know enough to conduct his own treatments.

Intraocular Tension in Electropexia. H. C. Ernsting.

Ophth. 22:54 (Jan.) 1939.

Elevation of the intraocular tension might occur in electropexia and prove a contraindication to the treatment of those eye diseases such as corneal ulceration, with the possibility of herniation or perforation of the cornea and glaucoma, in which such an event might prove disastrous. Study to determine the effects of this type of artificially induced fever on intraocular tension revealed that at the onset of treatment the systolic blood pressure may be elevated slightly, but after treatment it is lowered. During the maintenance period the basal metabolic rate is increased 5.5 per cent for each degree (Fahrenheit) of temperature elevation. A marked increase in the number and size of the visible capillaries and the rate of flow may be taken as a practical index of the circulatory changes that occur throughout the entire body during fever treatment.

Similar changes occur in the eye. The conjunctiva becomes injected, and it is a question whether the fundus does not appear slightly more vascular. The intraocular tension, which was determined under holocaine anesthesia and by means of the Schiötz tonometer, showed little or no change in 10 cases that were examined under treatment, but the tension, which was taken under the same conditions 30 minutes after treatment showed a definite drop in the majority of the 19 cases.

Subdeltoid Bursitis. Paul A. McIlhenny.

New Orleans Med. & Surg. J. 91:403 (Feb.) 1939.

Inflammation of the subdeltoid bursa, also spoken of as the subacromial bursa, produces a condition which varies from a moderate discomfort to complete disability of the shoulder, and is more frequently encountered than similar bursal conditions elsewhere in the body. Causative factors are trauma, direct and indirect, and infection. From the differential diagnosis standpoint there is one condition especially the symptoms of which simulate and often confuse in diagnosing the acute form, and this is rupture of the supraspinatus tendon. During the acute stage infra-red radiation is directed immediately over the bursa, and of uncomfortable intensity, for one hour daily. McIlhenny advocates that after ten days to two weeks of support the splint may be removed and gentle massage and active motions of the shoulder started. Physical therapy, including moderate active motions should be carried out. The author further states that in his opinion the future usefulness of the joint depends much on the cooperation of the patient in performing the corrective exercises prescribed. A maximum time of six months may be required for rehabilitation.

The Pathogenesis of Low-Back Pain. Edward L. Compere.

West Virginia M. J. 35:105 (March) 1939.

Compere states that the most common complaint of patients who come to the orthopedic clinic is backache. In his attempt to analyze the factors, Compere points out:

1. The largest group of patients, whose entrance complaint in the University of Chicago Clinics was that of low-back pain, was found to have clinical or roentgenological evidence of changes in the intervertebral disc L5 to S1.

2. The predisposing factors to this discogenetic lesion are: chronic malposture; heavy physical labor over a long period of years, and congenital anomalies, including spondylolisthesis.

3. A correct diagnosis can be made and the lesion localized, if the history of low-back pain is accurate and the examination is carefully made.

4. Errors in diagnosis and treatment may result when the complaint is of backache while the lesion is visceral, or when the symptoms produced by a lesion in the spine are manifested by pain referred to the abdomen.

5. The vast majority of cases of low-back pain can be relieved and the patient restored to functional usefulness without operative interference.

6. Correction of bad body mechanics by physical therapy, including stretching of contracted fascia or muscles, exercises, and the use of a good spine brace over a period of time, will restore the average patient to a reasonable degree of normalcy.

7. Orthopedic operations for the relief of low-back pain should be performed only after diag-

nosis has been accurately established and osseous neoplasms, visceral, or neurological lesions have been excluded.

Painful Shoulders. C. Elmer Carlson.

Northwest Medicine 38:52 (Feb.) 1939.

Painful shoulder is a disability frequently encountered. Many forms of treatment have been advocated for relief of these stiff and variably painful shoulders. Diathermy and other forms of heat are popular, and if used together with stretching exercises, probably help. The author believes that manipulation under anesthesia, in the severe cases at least, offers the best hope of restoration to function, and his technic is given. After the cast is removed more active exercise is prescribed, such as wall climbing, using the fingertips of both hands until vertical elevation is obtained; circumduction exercise, in which the patient bends over and swings the arm in gradually increasing circles until full range of rotation is obtained. Persistent active exercise as follow-up treatment is essential, but, the author claims, if faithfully performed normal or practically normal restoration of function may be expected.

Diagnosis and Treatment of Common New Growths of Skin. Sydney Thomson.

Practitioner CXLII:847 (Jan.) 1939.

Capillary haemangiomas, "port wine stains," can be ameliorated to some extent by prolonged courses of electrolysis, but they can never be entirely eliminated. Flat moles of average size can be treated by local injection of 0.3 per cent hydrogen peroxide, but better results are obtained by fulguration through a small electrode. The depth of destruction can easily be gauged, as the tissue is converted into dry powder which can be brushed off. For the average protuberant mole electrolysis is probably most useful. The negative pole is used and a current of $1\frac{1}{2}$ milliamperes is passed for about fifteen seconds at each insertion. First the hairs are dealt with by cauterizing the follicles (actually the hairs are large and often need 2 milliamperes), and when they have been removed by forceps the body of the mole is dealt with. It is transfixed repeatedly, each insertion being immediately adjacent to its predecessor in one direction. The process is then repeated in another direction. It is important to keep the needle slightly above skin level so that later shrinkage does not cause a depressed scar. At the end of the operation the mole is distended into a pale swelling with a surrounding erythematous reaction. The latter disappears within two hours and the mole dries up into a scab which drops off ten to fourteen days later, depending on its size. The method is slightly painful but can be employed without any anesthetic, in patients older than twelve years. Local anesthesia is undesirable for this

work, as there is slight distortion of levels and sometimes interference with healing. The galvano-cautery necessitates a local anesthetic and is not so easily controlled as electrolysis. Radiotherapy in whatever form is practically useless.

Larger warts may be frozen with an ethyl chloride spray and then scraped out with a sharp spoon, afterwards painting the wound thoroughly with a 4 per cent solution of silver nitrate.

Some Observations on Shoes. Thomas Marlin.

Brit. Med. J. (Dec. 3) 1938.

The foundation of a shoe is the insole, and on this the shoe is built. The insole is that part of the shoe with which the sole of the foot comes in contact, and therefore, corresponds to the ground when barefooted. If this is carelessly or wrongly made, if it is irregular, has bumps and hollows or sharp edges, or if during wear it develops these defects, then it can cause crippling of the feet and paralyzing effects on the body generally. In a correctly made shoe with a proper insole fatigue of the foot and body is eliminated, the foot and toes are able to expand and work against resistance of the insole, thereby receiving vital stimuli which are communicated to the rest of the body.

Girls' shoes should have flat heels with a good superficial area in contact with the ground. But at some peculiar transitional period in their lives the girls suddenly appear in shoes with heels of varying heights and diminished superficial area. Now, however, much we may wish we could alter these matters, they seem to be beyond our control, because the ladies are determined to have their heels high. And the practical fact is that high heels seem to be necessary for 90 per cent of our women folk — they feel better in high heels than in low heels. Instead of simply condemning high heels it would be better for us to try to obtain a sensible heel at the height women want. This does not mean that spindle-shaped heels three inches high should be worn, but one should not object to one and a half or even two inch heels. Very pointed heels are bad because of the difficulty of balancing, and we must also guard against heels which come so far forward that the wearer is all the time tending to over-balance backward.

Salivary Influence on Galvanism.

Much has been written indicating that the electrical potential difference between dissimilar metals may produce damage to the mouth when such metals are used in dental restorations. Solomon and his co-workers have recently reported a series of ingenious experiments to determine whether differences of potential actually exist between dental metals when saliva is the electrolyte. While the initial currents with saliva as the electrolyte are greater than currents with an artificial saliva, the final values are lower,

showing that some action other than polarization is occurring, namely, film formation. They conclude therefore that electric current is not normally flowing in the mouth containing dissimilar metal restorations. Although they do not maintain that electrical action resulting in damage to the soft tissues cannot exist in a mouth, the so-called protective mechanisms must be removed in order to permit current to flow. These investigators contend that there is no connection between the current readings obtained by placing a meter between metallic restorations in the mouth and damage to tissue.—[Abstr. J. A. M. A. 111:2306 (Dec. 17) 1938.]

X-Ray and Ultraviolet Light in the Treatment of Dermatophytosis. Onis George Hazel, and Carl Brundage.

South. M. J. 31:1297 (Dec.) 1938.

The value of the x-ray and ultraviolet light in the treatment of dermatophytosis has been a subject of considerable controversy among dermatologists. Since 1930, only two articles have appeared in the literature in regard to the use of x-ray in the treatment of dermatophytosis. In the treatment of an eczematous eruption, in which fungi play a part, the first consideration is that one is dealing with an eczematous dermatitis on a sensitization basis; the second consideration in the treatment of fungous infections, as in all other infections, is the choice of drugs which have a special affinity for the organism with the least damage to the tissues; the third consideration is the choice of drugs and physiotherapeutic methods particularly the x-rays, which will increase the local tissue immunity and make an unfavorable soil for the growth of the organism. One should attempt to make a definite diagnosis. This can best be done on a clinical, microscopic and culture basis. The broad term "dermatophytosis" includes all types of dermatoses of the extremities due to fungi, yeasts and molds. Fungous infections of the nails are very resistant to all types of therapy. The nail and soft tissue cases due to monilia often respond to x-ray, gentian violet, and aluminum acetate soaks. In chronic eczematous dermatoses of the hands and feet, inquiry is made as to the previous medication and the number of light treatments. Care should be exercised in order not to suggest that the patient has been overtreated. The suspicious patient is assured that he has not had an excessive amount of x-ray, but that additional x-ray would not be of any value. Cases in which the previous x-ray dosage cannot be accurately ascertained should not receive further x-ray therapy.

Over-treatment with x-ray of any eczematous dermatitis in which fungi bacteria or external irritants play a role will reduce the local tissue immunity until the conventional dermatological remedies are of very little value. Ultraviolet light, although possessing certain fungicidal and bacterial properties, is of limited value in the treatment of dermatophytosis.

Present Status of Fever Therapy. Lynn T. Hall.
Iowa State Med. Soc. 28:599 (Dec.) 1938.

Encouraging reports have appeared attesting to the success of fever treatment of infectious chorea. The carditis has not seemed to be a contraindication, if present. Whether fever is induced by foreign proteins or by other means, the results have been equally good. In bronchiectasis general improvement usually follows the use of fever therapy. The amount of sputum becomes less, increase in weight and general improvement in health occur. Reports have shown reduction in the size of cavities and lesions have coalesced and become smaller. In intractable asthma a number of favorable responses have been noted in patients who have not been able to obtain relief from any form of therapy. While no cures have been observed, occasional sufferers have experienced long remissions of paroxysms. Short treatments at low temperatures once a month suffice.

Although inflammatory disease of the kidney is regarded as a contraindication to fever therapy, nephroses have been reported materially improved following the use of pyretotherapy. Fever therapy, however, disappointing in the treatment of such diseases as subacute bacterial endocarditis, tuberculosis, mycosis fungoides, epidemic encephalitis, scleroderma, Hodgkin's disease and arteriosclerosis. It is not unlikely that interesting as well as favorable results will follow attempts to treat diseases other than those of the infectious group. Metabolic disorders, blood dyscrasias, parasitic infections, tropical diseases, all forms of neoplastic growths and even leprosy may yield to some form of fever. One might safely hazard the prediction that combined fever and chemotherapy will soon be the accepted treatment for primary syphilis. In view of the vasodilation noted, its use for arterial hypertension or angina pectoris is suggested. This new form of treatment, so striking in many particulars, will no doubt prove to be effective in many diseases as yet not studied. Further intensive effort, guided by physiologic and biochemical research, is needed to point out the fields of usefulness. Careful selection and good judgment are essential.

Elliott Therapy of Pelvic Inflammation in the Negress. George A. Williams.

Southern M. J. 31:1171 (Nov.) 1938.

The results obtained from adequate treatment were arbitrarily classified as: (1) anatomically and functionally well, those cases which presented no residual signs or symptoms of their illness; (2) symptomatically well, a much larger group which retained evidence of disease varying from mild tubal thickening to "frozen pelvis," but in

whom there was no disability from menstrual disorders, intermenstrual abdominal or pelvic discomfort, backache, urinary symptoms, or dyspareunia; (3) improved, a group in which marked amelioration, often temporary, was induced by treatment but which could not be regarded as satisfactory result; (4) patients unimproved except that acute symptoms subsided and abscesses resolved, and (5) deaths.

In the 202 suitable cases treated the end results were: anatomically and functionally well, 28.7 per cent; symptomatically well, 30.7 per cent; improved, 22.7 per cent; unimproved 15.8 per cent; and deaths, 1.9 per cent, all of which occurred in the abscess group.

The results obtained in this series were not so favorable as those reported elsewhere, presumably in white, or white and colored patients. As elsewhere, the best results were obtained in the acute lower tract and tubal inflammations, while chronic cases with "frozen pelvis" responded least satisfactorily. The results obtained in the latter class, however, were far better than from any conservative methods previously used. The successful results were particularly striking in cases of localized pelvic abscess. It should not be presumed, however, that Elliott treatment alone is better than when combined with surgery, because there were no deaths in the former group. The abscesses subjected to surgery were usually those which were larger or more serious on admission or they did not show immediate improvement under Elliott therapy.

Ingrown Toe-Nail—Operation by Electrosurgery. Sidney Vernon.

Am. J. Surg. 42:396 (Nov.) 1938.

The operation suggested is intended to remove the pathologic process in the ingrown toe-nail. This essentially consists of an infected granulation tissue at the edge of the toe-nail. The operation provides adequate drainage with the least economic loss and the minimum of discomfort to the patient. The advantages are: (1) The nailbed is not exposed; therefore there is less pain and the patient can return to his occupation immediately. (2) The electrocutting causes a soaring of the nerve axons that reach the wound and these are less likely to transfer painful impulses. This contributes to postoperative comfort. (3) There is no bleeding after the operation, the dressing can be very small, the shoe can be worn and the patient can go back to his job. (4) This operation removes all the pathologic tissue, and nothing more. (5) There is less possibility of extending infection after electrosurgical incision. Therefore, infected cases in which operation would have to be preceded by soaking in antiseptic solutions for several days can have immediate operative attention.